GEOGRAPHY OF THE PENNYROYAL

CARL ORTWIN SAUER

The

Kentucky Geological Survey

WILLARD ROUSE JILLSON
DIRECTOR and STATE GEOLOGIST

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Geography of the Pennyroyal

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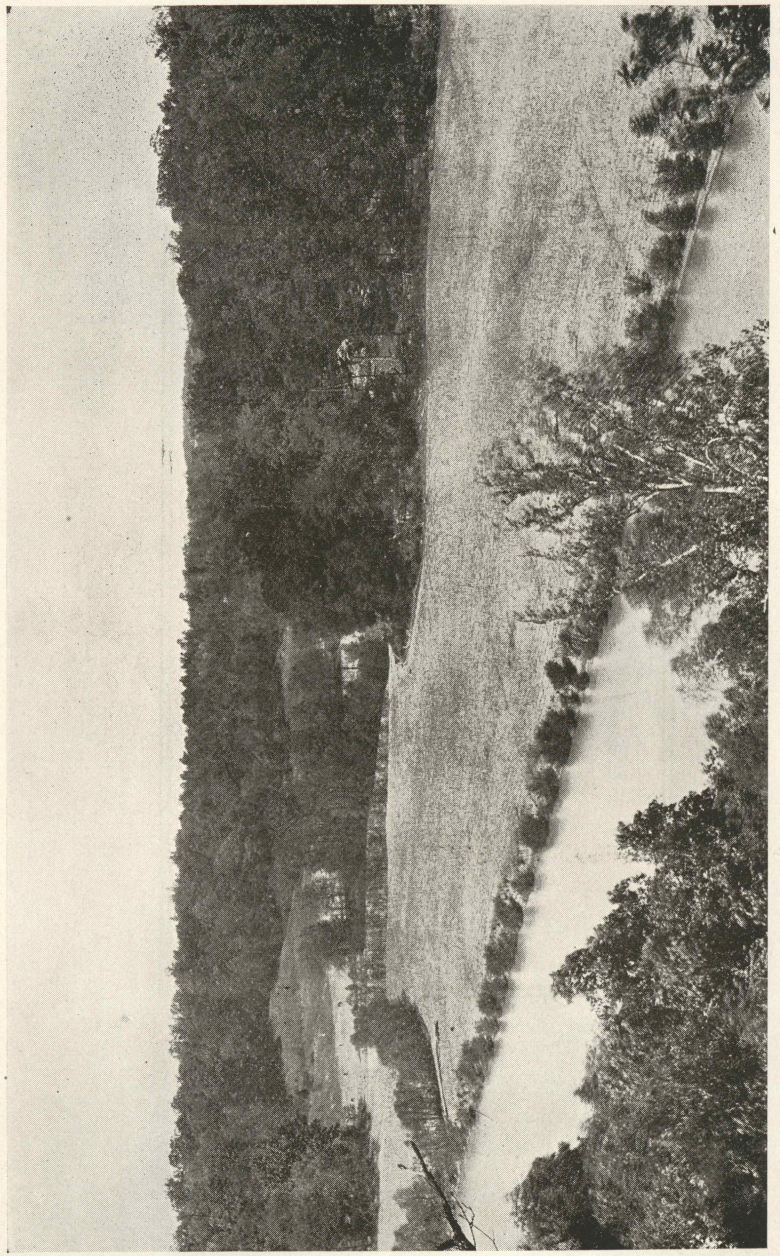

PHOTO BY W. R. JILLSON

THE GREEN RIVER VALLEY BELOW BROWNSVILLE

This stream rises in the eastern part of the Pennyroyal and has been a factor of major significance in the life of the district. This view is characteristic of the topography from Munfordsville to Brownsville.

GEOGRAPHY OF THE PENNYROYAL

A Study of the Influence of Geology and Physiography upon the Industry, Commerce and Life of the People

BY

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Illustrated with One Hundred and Twenty-five Photographs, Maps and Diagrams

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Preface

To an unusual degree the various geological surveys of Kentucky have joined geographic and geologic considerations. The initial survey of the state, conducted by David Dale Owen, concerned itself not only with the history of the rock formations and of their economic possibilities, but made some of the earliest and most important contributions to the geography of the state. Our knowledge of the original or early character of the native vegetation, of soil qualities, of land forms, in short of most of the physical features that were significant in the development of the state has received invaluable contributions from the publications of the first survey. In later surveys the geographic interest was served in particular by a series of excellent studies of forest distribution and by contributions from Professor N. S. Shaler and Professor A. M. Miller. Shaler, one of the greatest geographers of America, as well as a famous geologist, was Director of the Kentucky Geological Survey from 1874 to 1880.

This older, liberal tradition has been revived under the present administration, that of Dr. W. R. Jillson. Few states show as great a range of physical contrast as does Kentucky, or are better divided into natural regions with differing economic development. These natural units have been made the basis of a series of studies in regional geography under the direction of Dr. Jillson. The first of these studies, The Geography of the Jackson Purchase, by D. H. Davis, was issued in 1923. Since then, the "Mountains," the "Knobs," the Bluegrass, and the "Western Coal Fields" have been studied similarly. The present volume is the concluding one in the regional series. The six reports in question constitute the first completed series of regional geographic studies made for any state in our country.

The field of regional geography is not concerned with an encyclopaedic compendium of facts that are bound together simply by their occurrence in a particular region. Nor is its purpose to write the last chapter in the geology of a region. The dominant theme, as conceived in this report, is the expression of the individuality of the region, as the site of a particular

group of people and of their works. To begin with, there is the physical fact of the area, characterized by a distinctive location, by a climate, and by a particular body of land. The natural region consists of an area which, in the sum of its physical characteristic, is set off from adjacent regions. This physical site has been occupied by a group of people or by successive groups. The occupation has led to a series of characteristic contacts with the area, or "cultural" forms. Man's areal activities are expressed by the kind and distribution of his homes, storerooms, workshops, highways, fields, and other marks of his tenure. These marks which man has inscribed in the landscape are the cultural forms with which we are concerned.

Many of man's activities vary from place to place. There are more homes in one place than in another, better ones or worse ones. The type of farming changes from place to place and the nature of the other industries. This areal differentiation of cultural impress is the main body of material with which regional geography is concerned. These facts it attempts so to order that they may be grasped in their essential relations. That we may understand the culture of an area it is necessary to consider first its physical characteristics. Climate, soil, and surface are materials out of which or by means of which the cultural forms of area have been made. What men do in a country is, however, determined in the end primarily by man. The physical equipment of the area sets limits within which there is a wider or narrower choice of activity, as the case may be. Physical resource, stock of people, and time are the elements out of which results the full geographic expression of the region. The region is not simply a mass of ridges and valleys, of rich soils and poor soils. In it are farms and forests, towns and highways, manifold cultural forms. The changeful combination of these features, the areal pattern of the natural landscape as overlaid by a cultural landscape, the how and why thereof are the object which this volume attempts in some measure to answer for one of the regions of Kentucky.

Because south-central Kentucky presents an unusual diversity of conditions within short distances and, by American standards, is a region of fairly stable culture, for a number of summers, beginning in 1920, I brought students in geography

from the University of Michigan to this section. Most of the time of these groups was spent in the upper Cumberland Valley, in the eastern part of the region for which the vernacular name "Pennyroyal" is used in this report. Thus a gradually increasing familiarity developed with the area, otherwise little known to geographers. I gladly accepted the offer from the Director of the Kentucky Geological Survey to prepare a geographic study on this section, but, shortly after, a change in plans, involving my removal to the Pacific Coast, made it impossible for me to complete the project according to the original plan.

A division of labor was therefore undertaken, thus allowing intensive study of a series of small areas as types of the major subdivisions of the Pennyroyal. These type areas were studied independently and mapped by Mr. Leighly, for the eastern sections, and by Mr. Newman, for the western ones. Because of the lack of preexisting detailed surveys it was necessary for the most part to construct the maps in their entirety in the field. Mr. Leighly has also undertaken with fine care and creative skill the design and execution of the maps and drawings reproduced in the report. Dr. McMurry has prepared in large part the economic data, and the chapters on urban development and on transportation were prepared by him, in the main. To these loyal coworkers my sincere appreciation is here expressed.

The explanation of the multiple authorship of the report is therefore this necessary division of labor, not any pretense at ambitious treatment. The study has been deliberately experimental as to method, since examples of regional study are not numerous as yet in American geography. The experiment has been valuable to those who have engaged in it; perhaps it may contain some suggestions of interest as to method for other students of geography.

In many ways local residents have aided those who engaged in this study. The honorable traditions of Kentucky, according to our experience, have not fallen into disuse. Much oral information about conditions, present and past, has been utilized in the report. In many places the people of the area speak through these pages, small farmer of mountain cove and big tobacco planter, the judge traveling about his circuit and the town banker, the river pilot of the Cumberland and the lumberman,

even the transgressor, nonconformist only in regard to that item of the legal order as to the manner in which he shall not market his corn. We have tried to report correctly all of them as to their conditions and problems, by attempting to supplement the critical view of the outsider with a sympathetic understanding from the view-point of the inhabitant.

CARL O. SAUER, *Geographer.*

Berkley, Calif.
April, 1925.

GEOGRAPHY OF THE PENNYROYAL

CHAPTER ONE: INTRODUCTION

THE AREA IN ITS GENERAL SETTING

Kentucky, a Southern March

Before taking up the characteristics of the specific area of this report, it seems desirable to note those relations which the Pennyroyal bears to more inclusive areas and through which it is to be placed in a general regional classification. The State of Kentucky, in which the Pennyroyal lies, belongs to the South, both as to its climate and culture. The South is a major cultural division of the United States, perhaps its most strongly outstanding cultural unit, by reason of a common tradition derived from the ante-bellum period, a similar ancestry, and common economic interests.

The whole of the South is contained within the limits of one climate, the East Coast Humid Mesothermal Province (classification of Koeppen), and is nearly coextensive with that climate, as developed in the United States (Figure 1). Within the meso-

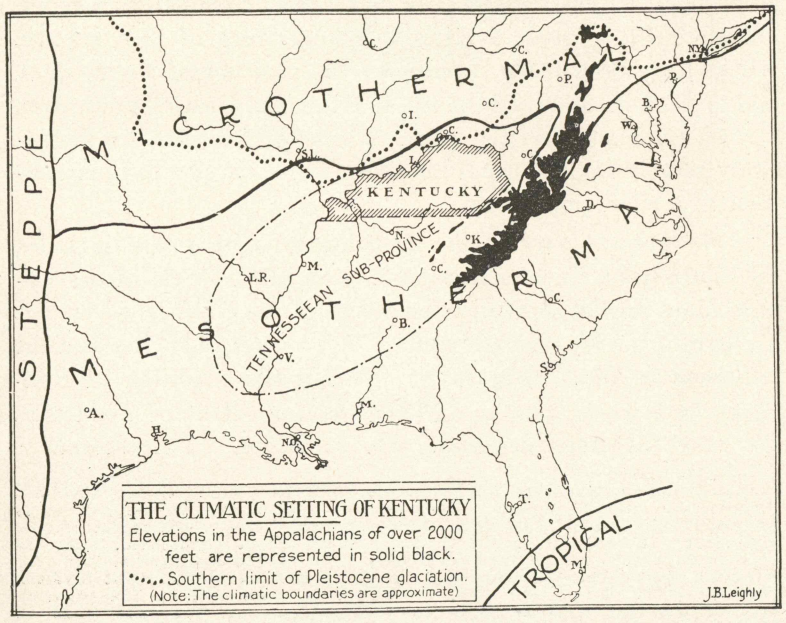


FIG. 1. THE CLIMATIC SETTING OF KENTUCKY.

thermal climates winters may be cool, but they are neither cold nor protracted. By definition areas are excluded in which freezing weather normally lasts for more than a few days at a time. The mean temperature of the coldest month lies above 30 to 32 degrees Fahrenheit and consequently the average midwinter day has at least a midday temperature above freezing. Winter temperatures therefore are not sufficiently low ordinarily to maintain on lowlands a snow cover for more than a few days at a time, nor to have winter precipitation predominantly in the form of snow, nor to cause the soil to be frozen annually. No part of Kentucky has the mean of the coldest month below 32 degrees, the minimum mean monthly temperatures in the Pennyroyal averaging 36.4 degrees. The East Coast type of the Mesothermal Climate has long warm summers, the mean of July being 77.4 degrees in the Pennyroyal.

In all of the South the rainfall is well above the average of the country. The rainfall of the Pennyroyal, averaging 47.9 inches annually, is probably close to the average for the entire South. Unlike certain other mesothermal climates the South has no pronounced dry season. The South has preeminently a forest climate, with a great variety and luxuriance of tree growth. Farms have been made usually by the clearing of forest land, and typical mesothermal plants, Indian corn, tobacco, and cotton furnish the characteristic crops. Farms and forests are attractively mingled in the usual Southern scene, supporting predominantly a rural population.

The greater part of the mesothermal region that includes the South has a summer maximum of rainfall. West of the Appalachians and at some distance north of the Gulf, however, lies a region in which the maximum of rain comes in spring and the minimum in fall. (Figure 1.) This is the condition of Kentucky as a whole, and to an even greater extent of Tennessee. We may therefore designate this subregion "Tennesseean."[1]

[1] Henry's classification of American climates recognizes a "Southern Appalachian and Tennessee" sub-province, with a late winter and early spring maximum. It appears, however, that the Appalachian slopes represent a transition to the Atlantic Coast coast conditions, that the type is developed in its pure form only west of the mountains, and that here the opposition of spring and fall precipitation is the most striking characteristic. The name may, therefore, be shortened by the elimination of the Appalachians from the designation, as was recognized by R. De C. Ward, Rainfall Types of the United States, Geo. Rev. (1917), pp. 131-144.

In general the amount of rain during the winter months is somewhat greater than during the summer. The distribution of precipitation is particularly favorable to forest growth and to the

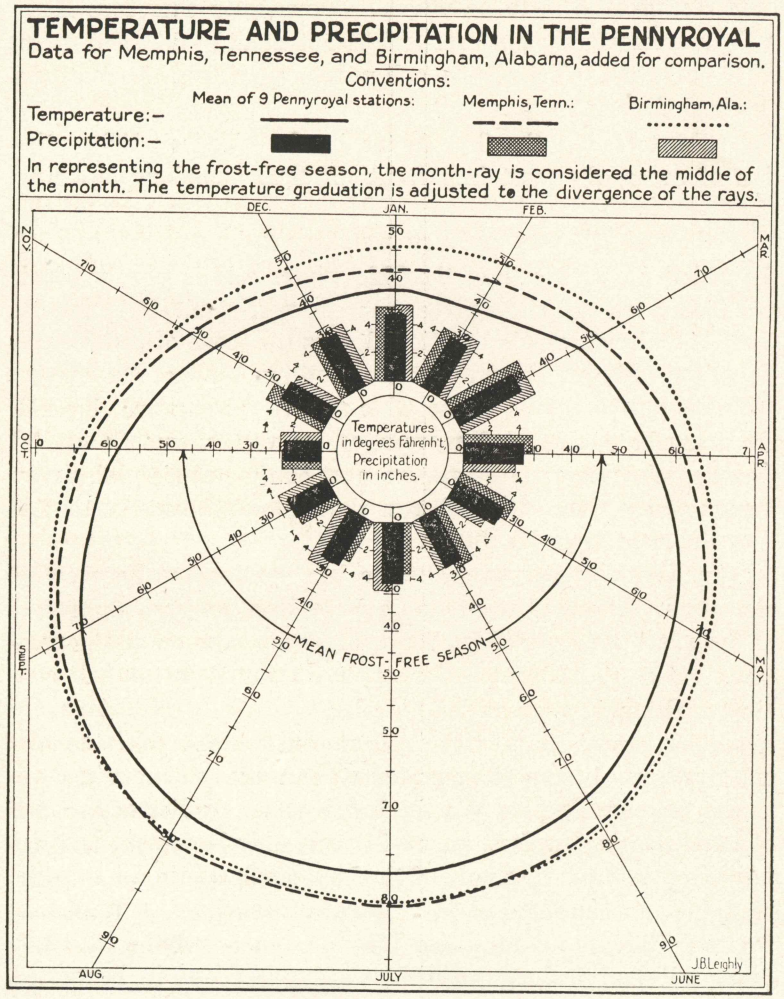


FIG. 2. TEMPERATURE AND PRECIPITATION IN THE PENNYROYAL

proper maturing of corn, cotton, and tobacco, but not equally favorable to the planting of these crops. The maximum rain comes at a season that is conductive to soil erosion. A graph of the climatic elements in the Pennyroyal is given in Figure 2.

The minimum rainfall in the Pennyroyal is in October, 2.62 inches, the maximum in March 5.06 inches. For comparison climatic graphs of Memphis and Birmingham are added. Their close resemblance is to be noted. Climatically therefore Kentucky is remarkably uniform and is not notably different from other parts of the Tennessean sub-province, an area of about two hundred thousand square miles.

Climate being the first factor in the physical differentiation of areas, the most important physical boundary affecting Kentucky is the line between the Mesothermal Climate and the Microthermal Climate, or very roughly, the northern slope of the Ohio Valley. North of the Ohio winter cold is more marked, and frozen soil and snow cover are more persistent. It is notable that this Microthermal climatic belt was the scene of continental glaciation (Figure 1) and that the southern limit of the glacial drift is approximately at the Ohio River. Northward, beyond the immediate, dissected margin of its valley, smooth glacial plains predominate. This eastern part of the prairie plains now is part of the Corn Belt. Across the Ohio is a country that is very different from Kentucky.

In Kentucky the land surface has not been made over by glaciation. The land forms and soils of Kentucky are the result of the weathering of bedded rocks, of stream erosion and deposition, and of the solvent action of underground waters, all continued through a great length of time. Rock exposures are abundant, especially as cliffs along stream courses. Isolated hills mark resistant bodies of rock, remote from stream channels. Even in the best farming regions the bed rock rarely lies at a depth of more than a few feet, except in the valley bottoms. Streams have fretted the major part of the land surface into a landscape of ridges and valleys, except where underground solution has formed pitted or undulating surfaces. Closely related land surfaces, soils and drainage conditions are to be found in Tennessee, Arkansas, and the other states of the Upper South.

Culturally, the inner Ohio Valley is equally important as a border line. Not only does the type of farming change as one crosses the valley, but urban development is strongly differentiated. On the smooth plains of Ohio and Indiana, forming moreover a corridor between the seaboard and the interior states, with

the Great Lakes to the north and the hills of the Ohio Valley to the south, commercial and industrial centers have sprung up in number. Ohio, Indiana, and Illinois are becoming increasingly industrialized and are largely dominated today by urban interests. Kentucky, and its southern neighbors, are still dominantly rural, served by few urban centers. Material changes in economic activity have not come with the revolutionary haste and brusqueness of the states to the north. South of the Ohio a sense of continuity with the past persists because change has been slow and the tempo of life has not been much accelerated nor its measure syncopated.

The northern boundary of the South may indeed be fixed at the Ohio, not simply because of climate and its manifold effects, but because of the historic westward thrust of Southern institutions and stocks to the Ohio River, forming of Kentucky an outpost, or "march," of Southern culture. Kentucky, to begin with, was a part of Virginia, the Ohio, a known line through the wilderness providing a convenient and valid political boundary in the preliminary subdivision of the western country. The lands south of the Ohio became available to settlement at a time when the northern bank was still Indian country. The Northwest Territory, lying north of the Ohio, was a wilderness of unknown extent. The territory south of the river was frontier Virginia. The seaboard states to the east of Kentucky became overcrowded during the eighteenth century under the economic conditions then existing. The Ohio River and the Wilderness Road from the Valley of Virginia led directly to the fertile lands of central Kentucky. In the third quarter of the Eighteenth Century the westward movement began and Kentucky was the first transmountain commonwealth established. These familiar facts of American history are worth keeping in mind: first, that the settlements were the oldest in the west; second, that they were formed by overflow population from a common hearth on the Atlantic sea-board; and third, that the Ohio River was for many years the northern limit of land open to occupation.

North of the Ohio settlement began later, the immigration came most largely by way of the Mohawk Valley and the Great Lakes, and the stock was drawn from the northeastern states and

from northern Europe. Southern migration pushed northward across the Ohio to some extent, but was met and overwhelmed by migration coming from the Great Lakes, which forced its way down to the Ohio but never crossed that line effectively because of its prior and sufficient occupation. The larger cities along the Ohio show both sources of their population plainly, but south of Cincinnati and Louisville northern influences have scarcely made themselves felt. Any geographic study of Kentucky may well begin with the recognition of the sectionalism that has been defined by the banks of the Ohio River.

The present population of Kentucky is derived overwhelmingly from settlers who came within a single generation at the close of the Eighteenth Century. Virginians, Carolinians, and Pennsylvanians originally, of varied racial origin, they soon lost their distinctness in the effective melting pot of the isolated transmontane frontiers. Largely unaffected since then by intusions of later and alien stocks, the Kentuckians possess a very strong background of tradition and kinship. To the fifth generation and beyond they have been living together undisturbed in an area which is the only home that many of them know even by tradition. A large measure of state consciousness is therefore common heritage to the people of Kentucky, in whatever section of the state they may live, and however strongly they may have become differentiated in attainment and prosperity.

Kentucky is not only part of the South, but it is a distinct part thereof. Like most of our states it has apparently arbitrary, in part geodetic boundaries, yet these boundaries surround a well-defined nuclear area of superior attractiveness and prior settlement. In the case of Kentucky this is the Bluegrass, to which marginal areas are politically and economically attached. The ordinary process of development of an American state involved the emergence on the frontier of a detached, vigorously growing center, based on the discovery of a valuable and coherent new country. Out of this dominant nucleus in time a separate state commonly was formed. In the establishment of its boundaries convenient lines of demarkation were chosen, commonly through regions of lower attractions, at the time unsettled or

still sparsely settled, so as to make the dominant settlement central in position and access to the newly formed commonwealth. The evolution of Kentucky from a frontier county of Virginia to statehood does no violence to the idea of an adequate nuclear area and of tributary marginal regions.

Cultural Regions and Natural Regions in Kentucky

In the early years of Kentucky there was little differentiation in cultural conditions. A homogeneous pioneer stock followed much the same livelihood in all parts of the state. Gradually however cultural differences appeared and became emphasized increasingly by the more rapid and more gainful utilization of some areas than of others. In some parts the pioneer culture has been changed but little. With the largely increased population there has come about in some parts gradual social retardation or even retrogression in standards of living. In other regions an increasing number of people have found a more abundant living. Quiet but persistent internal migration has been set up from areas of less opportunity to those of greater prospect. This continued cultural differentiation is in most intimate relation to differing physical equipment of the sections of the state, a difference that is not yet perhaps as fully apparent as it may be after a further lapse of years. A century and more of trial of the land however has been under way and has disclosed limitations and attractions that were not known at first. On the other hand, trials of new forms of land utilization are still under way or expected. At present there is a striking correlation in Kentucky of cultural conditions and of the physical individuality of the area, without implying of course that other times and other people might not find a different manner of living in the same area.

Popular knowledge of the differences in character of the several parts of the state is pretty well established and has expressed itself in popular names for all of the major natural divisions of Kentucky. This popular terminology it is true is current only for the most typical parts of the regions. Thus the designation Bluegrass is completely accepted only for the inner part of the central northern limestone plateau. In all cases however the most significant areal contrasts have been rec-

ognized and named. These popular divisions are adequate to serve as basis for the natural and cultural regions of the state. To an extraordinary extent, the geology of Kentucky is the key to the understanding of the physical differences of the state and of its cultural contrasts. Popular usage recognized, through landscape, the major geologic features of the state before systematic geologic work was done. The relation of geologic structure, natural landscape, cultural utilization, and common regional designation will be considered in the following paragraphs, Figure 3 showing the major divisions of Kentucky.

(1) The Bluegrass is essentially the area of major outcrop of Ordovician and Silurian rocks, mostly non-resistant limestones of high phosphatic content. The surface is a gently rolling midland. The soils are among the most fertile residual soils known. The country was obviously unusually rich, even to the eyes of the early hunter-explorers who carried east the fame of the "dark and bloody ground." Probably no area of the South has equalled this section in the cultural level of its rural districts or exceeded it in historical significance.

(2) The Kentucky Mountains are part of the dissected Cumberland Plateau, corresponding as to limits in the main to the area of outcrop of Coal Measures in the eastern part of the state. These coal measures commonly bear locally a cap rock of massive conglomerate or sandstone. The area forms the highest part of the state and rises toward the southeast to truly mountainous proportions. It is lowest at its western margin, but even there forms a distinctly higher and more rugged surface than the areas adjacent to it. Steep hills and crooked valleys compose the characteristic landscape. The upland soils are most largely thin and sandy, many of the valleys being developed however on limestone. The retarded Anglo-Saxon community of the Mountains is not a myth, nor is it the universal type. Moreover the region is experiencing an important revaluation through mining. Its coal resources are very great and assure to it a position of growing importance.

(3) The Knobs form a crescentic area about the southern margin of the Bluegrass, extending from Mudlraugh's Hill southwest of Louisville to the Ohio river above Maysville. They consist of sharp ridges and knobs, formed by the ragged fringes and

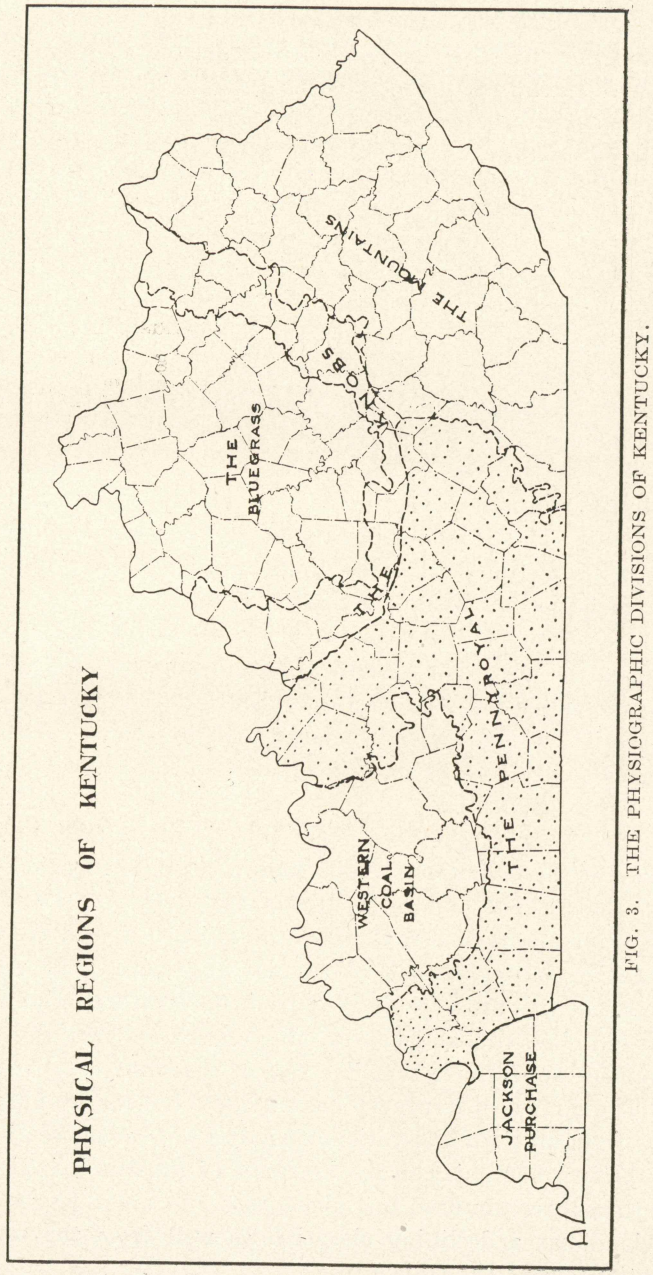


FIG. 3. THE PHYSIOGRAPHIC DIVISIONS OF KENTUCKY.

outliers of resistent Mississippian sandstones and cherty limestones, below which outcrop weak shales. The latter form a frontal slope toward the Bluegrass and broad, flat valleys between the ridges. These shales result in tight, leached, and, commonly, sour soils. The steep slopes of the uplands and the thin soils of the flats are not attractive for farming. Farms are small and agriculture is only rarely prosperous. The population has suffered a long-continued removal of its more ambitious elements to neighboring areas in the Bluegrass. The area is clearly defined toward the Bluegrass by the limits of the shale, but not so on its margin against the Pennyroyal. Here a more or less arbitrary line must be chosen, since the Knobs are simply the dissected fringe of the same Mississippian rocks that underlie the uplands of most of the Pennyroyal.

(4) To the west of the Knobs lies an upland region made up of Mississippian rocks, for the most part limestones and shaly limestones. This is known in part as the Pennyroyal and in part at least is sometimes still called by the older name of "Barrens." It is the region involving the present report.

(5) Between the Pennyroyal on the south and the Ohio River on the north is a structural basin composed of Coal Measures, and called the Western Coal Basin. In the central part the surface is low, determined in large part by shales. About the margins is a resistant rim of conglomerate and sandstone, forming very rugged hills.

(6) West of the Tennessee River is the northernmost extension of the Gulf Coast Plain, known to science as the Mississippi Embayment, but in Kentucky as "Jackson's Purchase." This is the one region of the state in which bed rock is not significant in the expression of surface and soils. The physical features of this area are derived from the weathering of unconsolidated clay, silt, and gravel. It is lower and less diversified in surface appearance than the rest of the state.

The surface of Kentucky has a general but far from uniform slope from maximum elevations of half a mile above sea level in the eastern mountains to the lowlands of the Mississippi River, less than three hundred feet above tide. In much lesser degree the land has a declining elevation as well from the southern counties toward the Ohio River.

THE PENNYROYAL, AS AVERAGE OR TYPE OF THE STATE.

Of the major natural regions of Kentucky the Pennyroyal is most intermediate in its characteristics. (1) It and the Bluegrass have the most central location in the state. (2) In climatic conditions it is not differentiated from the average of the state. In general it has the same native flora and produces the same crops as do the other sections. (3) It is contiguous to all the major divisions of the state excepting the Bluegrass, from which it is separated by a narrow strip of Knobs, traversed freely by lines of communication between Bluegrass and Pennyroyal. (4) The Pennyroyal Region is, and has been from the outset, closely connected with a ring of larger towns that nearly surrounds it. It has been tributary to all of them and accessory to their development. For many rural sections there is but one "City." Not so in the Pennyroyal. Here Nashville, Louisville, and even Cincinnati and Memphis may be virtually equally accessible. Of lesser, but independent centers about, there are to be mentioned in Kentucky, Lexington, Owensboro, Paducah, in Indiana, Evansville, and in Illinois, Cairo. (5) Surfaces and soils reproduce almost the entire range of conditions found elsewhere in the state. There are broad belts of rich limestone land that compare favorably with the Bluegrass and have a similar economic system. There are also dissected tracts with eroded soils and flats of sour land that are counterparts of the Knobs. There are even rugged and isolated regions which are strongly reminiscent of the "Mountains." (6) The average of cultural conditions is perhaps about the mean of the state. In density of population, size of farms, returns from farming, nature of crops, and forest utilization, the area is representative of the average in Kentucky.

The people of the Pennyroyal are characteristically Kentuckian, their site reproduces the typical conditions of other sections of the state in large part, and occupations are thoroughly representative of the state in general. The Pennyroyal, by its averages and extremes therefore, may be said to epitomize Kentucky better than any other section. This major conclusion constitutes a frequently recurring theme in the succeeding chapters.

CHAPTER TWO

BASES OF REGIONAL UNITY

The Interior Low Plateaus

Physically the Pennyroyal may be considered (1) on a climatic basis as part of the Tennessean Region previously described, and (2) as belonging surficially to the not highly coherent region intermediate between the elevated, dissected plateaus on the east, called the Allegheny-Cumberland region, and the Mississippi River lowlands to the southwest. The term "Interior Low Plateaus" (Fenneman) has gained some currency for this larger section in which the Pennyroyal lies. These Low Plateaus extend from southeastern Ohio to northern Mississippi and are contained almost entirely within the Tennessean climatic sub-province. They possess little unity in the geographic sense, except as a part of a larger climatic and cultural unit. They are an illustration of the fact that between well-marked major regions there may be found here and there intervening areas of less determinate character.

In the Low Plateaus the small but important Bluegrass and Nashville basins form the most sharply marked sub-regions. They are surrounded by higher land, hence the "Knobs" in Kentucky, the "Highland Rim" in Tennessee. The "Highland Rim," though sometimes used in Tennessee to designate the whole area enclosing the Nashville Basin, is really appropriate only for the immediate margin of this lowland and really should be used merely to identify the hill belt about Nashville, the exact equivalent term in Kentucky being "Knobs." The other Kentucky areas that belong to the Low Plateaus are the Western Coal Basin and the Pennyroyal. The Low Plateaus are simply an aggregation of minor areas, without major unifying characteristics, and the dilemma of their surficial classification is well expressed by their name.

Identification of the Pennyroyal by Contrast with Neighboring Areas

The Pennyroyal resembles the larger surface with which it is classed in the difficulty of defining it surficially as a unit

region. It is easier to say that it does not belong with any of its neighboring regions, excepting possibly the Clarksville area of Tennessee, than to specify its physical individuality. The distinctness of the neighboring areas is an important negative means of identifying the Pennyroyal.

To the southeast, the "Mountains" rise conspicuously, the boundary of the mountains being generally a narrow zone that lies within the range of vision of the observer at almost every point. The first mountain level is commonly at least two hundred and fifty feet above the level of the Pennyroyal, the rise taking place by steep, wooded slopes. In profile the contact between Pennyroyal flat and mountain slope is sharply angular. In plan the mountain front is broken at the Pennyroyal level by many valleys, called "coves" or "hollows." The coves and their intervening ridges are to be considered geographically in general as part of the Pennyroyal rather than of the mountains, because their connections and interests are with the lower surface into which they open, not with the mountains that coalesce into a massive barrier behind them. This border will therefore be considered as one of the subdivisions of the Pennyroyal.

Through general usage the northern, dissected margin of the upland surface to which the Pennyroyal belongs is recognized as a distinct region, the "Knobs." We can only affirm the validity of this usage, since it is the poor periphery of the Bluegrass, trade, political control, and population all gravitating toward the richer lowland. An expression of this relationship is to be found in the fact that most of the Knobs area is included politically in Bluegrass counties. The Bluegrass, disclaiming them as its own, accepts them as dependents. In popular usage the Knobs are not left behind in going from Bluegrass to Pennyroyal until the continuous, broadly rolling upland behind the dissected fringe is reached, that is, at or south and west of such places as Muldraugh, Tipton, Spurlington, and King's Mountain, stations on the several railroad lines that make the ascent to the Pennyroyal. On this front therefore the border line of the Pennyroyal is determined by the dissection of the upland so

as to exclude the rough areas, that form the rim of the Bluegrass, and the hills of Salt River, south of Louisville.[1]

The Western Coal Basin is achieving increasing unity through coal mining. The limits of the Coal Measures make a fairly satisfactory boundary against the Pennyroyal, because of the occurrence of an extensive belt of rugged country, developed on the basal Coal Measures.

The Jackson Purchase, belonging to the Coastal Plain, is obviously sharply contrasted to the hard rock country of the Pennyroyal. The Tennessee River has sunk its course along the very edge of the coastal plain sediments and thus forms a quite precise boundary between the two contrasted areas.

The relation of the surface of the Pennyroyal to that of the surrounding areas is graphically represented by Figure 4, with which should be consulted Figure 7.

Southward, across the Tennessee state line, lies the continuation of the Pennyroyal. All about Clarksville, Tennessee, surface soil, and production are very similar to the Pennyroyal. Historical connections with this part of Tennessee have been intimate and date back to the time of settlement. We are here, however, not interested in the Pennyroyal as a natural or cultural region or unit but simply with the Kentucky portion. Southern extensions of this region may find description elsewhere.

Physical Bases of Unity

Within the limits as thus defined lies an upland, underlain by a relatively homogeneous body of rock, charted on geologic maps as belonging to the Mississippian period, and consisting predominantly of limestones. Only one other Kentucky area, the Bluegrass, is a limestone country. The Pennyroyal lies distinctly higher than the Bluegrass and is derived from quite a different body of limestone rock. The precise limits of the Pennyroyal cannot be drawn entirely on the basis of limestone, but for the most part the Pennyroyal is limestone country, and at its margins lie sandstone and conglomerate areas. The "Mountains"

[1] An early allusion to the latter country as the backwoods limbo of those who have tried and fallen short in the larger area is found in Appleton's Handbook of American Travel under Salt River; "This is the fabled retreat of defeated politicians and other unhappy adventurers." To be 'up Salt Creek' is still a common expression in those parts of the West that have been affected by the vernacular of Kentucky.

are of standstone, the Western Coal Basin is similarly enclosed, and even the Knobs are capped in part by a basal Mississippian sandstone which is either buried or wanting through most of the Pennyroyal.

Physically then the Pennyroyal may be defined as derived from a broadly similar body of material, differing from adjacent formations and hence differentiated into a distinctive landscape, involving (1) an open, broadly rolling upland, (2) the extensive development of solution features, (3) a distinctive valley pattern, and (4) a soil series, not developed elsewhere in Kentucky.

The Region as a Corridor

As a human site, the Pennyroyal has functioned pretty coherently. It is true that it falls short of ideal geographic unity in its striking failure to develop a dominant nuclear center. It certainly has no strongly marked cultural individuality in the sense that is true of the Bluegrass or the Mountains. The Pennyroyal is scarcely conducive to epigrammatic summarization. These blurred conditions have nothing to do with the reality or non-reality of the Pennyroyal. The Pennyroyal exists because its people belong together, rather than elsewhere. It is a distinctive scene, but in subdued ones.

The geographic identity of the area is perhaps best expressed by saying that it is a corridor. As compared to the surrounding rugged hills and river "breaks" the limestone surface of the Pennyroyal is smooth and readily passable. It serves therefore as the principal connection between the Ohio Valley, Tennessee, and states to the south. In simplest terms the region may be thought of as a double corridor leading south from the Ohio and converging upon Nashville. One branch touches the Ohio at Louisville, the other begins in the area of confluence of the Cumberland, Tennessee, and Wabash rivers with the Ohio, or, approximately at the confluence of the Ohio system with the Mississippi.

The eastern branch of the corridor developed first as an overland route between the Bluegrass and Nashville. It was used especially by Bluegrass merchants and planters returning

by land from New Orleans and Natchez by way of Nashville.[2] These pioneer trails of the southeastern Pennyroyal are now followed by the principal highways of that section. Of even greater importance has been the Louisville-Nashville route which follows a very direct course through the smoother portions of the Pennyroyal and thus avoids most of the Knobs belt and the rough hills to the west, that border on the Coal Basin. This was at first a main-traveled Indian trail from the Falls of the Ohio to the Bend of the Cumberland.[3] Gradually two important highways of wheel travel developed through this belt,[4] now known as the Jackson Highway and as the western branch of the Dixie Highway. Here was located also the original main line of the Louisville and Nashville Railroad. The Cumberland River supplies an alternative route from the southern Bluegrass and the Mountains to Nashville through the Pennyroyal, now disused as a connection with the Bluegrass.

The western branch of the corridor was of early importance chiefly as a waterway and is still used as a connection between the Nashville area and the Ohio River. The river line is paralleled by land routes, both rail and wagon. This characteristic utilization of the region as a series of passageways between important centers has been of continuous significance in the life of the region and will be referred to repeatedly. Its "intervening" character is really its most significant trait.

Choice of the Name: "Pennyroyal"

The name Pennyroyal is here applied to the entire region as delimited. The name as popularly used is current only in the southwestern and southern counties centering about Hopkinsville, Russellville, and Bowling Green. This is the optimum or nuclear area. The name is proposed for the entire region, because it possesses the advantage of being simply the most

[2] Collins, Lewis, History of Kentucky (1877), p. 34, cites early inscriptions on beech trees in the southern Pennyroyal, made by travelers from the Bluegrass, such as one near Scottsville: "James McCall dined here, on his way from Natchez, June 10, 1770" (1790?). He also gives a detailed account of the celebrated Hamilton-Sanderson case of Metcalfe Co., in 1817. The principals were a trader returning from Mississippi after the sale of some livestock and a planter from the Natchez region who was on his way to the Bluegrass to buy slaves (Ibid., pp. 626-28).

[3] Shaler, N. S., History of Kentucky (1885), p. 29.

[4] See account by Featherstonhaugh, Travels, vol. 1, p. 229, of the return of the Nashville contingent from the races at Louisville.

widely current regional term, purely locational rather than genetic in its implication. Since it is popularly accepted for the best or most simple type area, the other parts of the region may be thought of as marginal variants from the optimum type or as enclaves, included because of their position within the dominant region.

Other names of genetic connotation have had varying degrees of usage. An historic term of local use is the "Barrens," descriptive of the treeless character of much of the region at the time of settlement. Large parts of the region were, however, forested and parts of the original Barrens have become partially forest-covered. The name therefore was never appropriate for the entire section and its implications are not at all correct for the region at present.

The term Cavernous Limestone Plateau has also been used. There are in the region, however, large bodies of shaly limestone that have not developed ordinarily cavernous features. It is also necessary to include within it as enclave part of the Cumberland Valley which has no cavernous characteristics.

A purely geologic designation is that of Mississippian Limestone Plateau. There are of course limestone uplands derived from this formation in other states. The fact of geologic age is not directly significant to geographic characterization. The term is moreover inaccurate even for Kentucky, since it would demand inclusion of much of the Knobs country which is popularly and properly recognized as a distinct region. It would also fail to provide for the Cumberland Valley, which below Burnside is an integral part of the area by reason of its position.

It appears necessary therefore to expand on popular usage and apply to the whole area the name of the fragrant mint which thrives on these limestone lands.

CHAPTER THREE

THE DRAINAGE PATTERN AND ITS MEANING

Forces and Results

The present land surface is the result of climatic processes operating upon the local rock materials through long periods of time. The Upper South is very old land geologically, the youngest hard rock formations being in general the Coal Measures. Since then the region has been subject to the attack of predominantly degradational forces of climate. It is not possible to assume that the same climatic conditions have prevailed through all this time, but it appears that during most of its later geologic history the climate has been markedly pluvial as at present and that temperatures have been moderately high. The action of running and percolating water together with chemical weathering seems therefore to have been dominant in shaping the local land. The effect of these processes has been to remove gradually the beds of rock that originally covered this region and to expose increasingly lower-lying beds. There have thus been important changes in the rock materials out of which the surface was fashioned. Finally, the region has been subjected to repeated changes of elevation, the most legible of which were uplifts.

The present relief features, soils, and drainage forms therefore represent the effects of a climate, probably somewhat changing, on rock bodies, some of which no longer exist, and on a surface at different times differing in elevation above the sea and in distance from it. The landscape of today contains numerous physical features that are relics of earlier periods of erosion, the history of which we know only very imperfectly. The genesis of these older land forms is illuminated in particular by certain qualities of pattern in the local drainage, which may be classified for the area as a whole and which are conspicuous in the landscape both physically and culturally.

The Cincinnati Arch

Before any of the present land features were formed the region was involved in an extensive crustal deformation, in

which the Lexington and Nashville rock domes were produced. Between the two domes, the rocks of the Pennyroyal were bowed less. A distinct arching, however, extends across the Pennyroyal from Allen and Monroe counties at the south to Taylor and Casey counties on the edge of the Bluegrass. (Figure 7.) The entire deformation is known to geologists as the Cincinnati Arch. On the southwestern flank of the arch in the Pennyroyal numerous minor folds were developed. The features of deformation have been significant in the expression of drainage and topography.

General Classification of Drainage

In general the rivers are the most ancient features of the local landscape, a number of the stream courses having been established on surfaces and materials that have long since disappeared almost entirely from the region. Figure 5 shows the following notable characteristics of drainage: (1) The subparallel Southeast-Northwest trend of the southern affluents of the Ohio in the lower parts of their courses, with a decided increase in length of this alignment for the more easterly streams; (2) the reappearance of this trend in portions of the upper Cumberland and Kentucky rivers and in a number of their larger tributaries; (3) The skewing into an east-west direction of the middle courses and drainage basins of the Cumberland, Green, Salt, and Kentucky rivers; (4) the manner in which the upper drainage of the Cumberland extends northeastward, truncating the present drainage basins of the Green and Kentucky rivers; (5) the asymmetrical position of the Upper Cumberland in its drainage basin, with the result that the right hand tributaries, situated on the flank of the Cincinnati Arch, are peculiarly short; (6) the abnormal angles of confluence common to the upper Cumberland Valley and to the tributary valley of Rockcastle River.

These major trends of drainage in Kentucky and Tennessee for the most part have no relation to present distribution of rock formations. The geologic conditions of the area would hardly be deduced from a drainage map, except for the suppression in large part of small streams on the cavernous limestones. This drainage pattern has received little attention in studies of the erosion history of the Appalachians and their western forelands.

It appears that such an unusual drainage system, developed over formations of strikingly different resistance to stream erosion could have been brought about only (1) if the drainage was developed before the present formations became exposed, (2) if warping was involved, or (3) if the pattern was formed on a land surface that was too low in relief to give effectiveness to difference in resistance of rock formations. The last two conditions appear to have been significant locally, as suggested in the following analysis.

The Oldest Stream Courses

Before the present Appalachian Mountains took form, an ancient watershed lay diagonally across the present crest-line. In the latitude of Kentucky this old water-parting lay well to seaward of the highest part of the modern Appalachians.[1] The land then sloped from the Piedmont of Virginia and Carolina down towards the Ohio. On this long slope important streams established themselves and continued for a long time, finally perhaps reducing the land to a broad plain. The northwesterly trend of drainage, charactertistic of eastern Kentucky and of the lower stream courses from the Salt River west, corresponds to what we know of this slope of land and indicates that the major streams were established during this period. Hayes and Campbell find in Cumberland Gap, a wind gap on the Kentucky-Virginia-Tennessee border, evidence of the drainage at this time of northeastern Tennessee into Kentucky.[2]

The Second Erosion Period

It is notable that the tributaries of the Ohio in West Virginia and in eastern Kentucky still preserve throughout their whole length for the most part this primitive northwesterly trend of the oldest erosion period and that they have reasonably symmetrical drainage basins, whereas from the Kentucky River westward the middle drainage basins and the stream courses

[1] Still the best account of the evolution of the land surfaces of southeastern United States is Hayes and Campbell, Geomorphology of the Southern Appalachians, Nat. Geog. Mag., vol. 6, pp. 63-126 (1894).

[2] Their assignment of this drainage to the Cumberland appears questionable. It seems more likely that the waters discharging through Cumberland Gap were part of the ancient drainage system of the Kentucky River.

without exception are skewed west and east very strongly. This condition is most typical of Pennyroyal drainage but affects as well the Western Coal Basin and the greater part of the Bluegrass drainage, in consequence very different rock formations. The change in direction of drainage is correlated with an upwarping of the land following the earlier erosion period.

The strong warping of the second period had its major axis extending northwest-southwest along the present line of maximum elevation of the Appalachians. The general uplift of the Kentucky Mountains appears to date from this time. The streams of eastern Kentucky and of West Virginia were rejuvenated and their valleys cut down, but they held approximately to their old courses. The work of Hayes and Campbell in Tennessee has shown a secondary axis of uplift, as extending northward from Chattanooga toward the Ohio River, roughly parallel to the line of the Queen and Crescent Railroad. This secondary axis tilted the old land surface to the west below Rockcastle Valley.[3] If the older land surface was reduced as much as is generally supposed, drainage down the western flank of the Chattanooga anticline was inevitably rearranged to follow the newly changed and steepened slope. The drainage of the middle Cumberland and upper Green River is at right angles to the axis. The same may be true of the middle Kentucky. This skewing therefore is interpreted as being consequent to a deformational surface which replaced an older base-leveled surface.

In this second stage of erosion differences in rock formation appear to have become highly effective in determining the growth of stream systems. The Cumberland had discovered the weak strata of the Nashville Basin and thereafter had an important advantage in extending its headwaters. The Green River became handicapped by the uncovering of the Cincinnati Arch to the horizon of the Waverly beds, which formed across its upper course a mass of resistant materials, largely shaly limestones of low solubility, fortified moreover by strong beds of chert. The Cumberland avoided these materials at this time and from its

[3] The amount of upwarping decreased northward and the further course of the axis through Kentucky is poorly known. The trend of the drainage of the upper Kentucky suggests a displacement of the axis well to the east of the line assumed by Hayes and Campbell.

point of vantage in the low Nashville Basin appears to have worked northeastward along the axis of the Cincinnati Arch gradually shifting down dip to the eastern flank, and thus to have intercepted and diverted to itself the upper basin of the Green. Crocus Creek, in Adair and Cumberland counties, particularly suggests reversed drainage as does the abnormally short length of the righthand tributaries of the Cumberland along the flank of the arch. The drainage of the Cumberland Basin above the Tennessee line is strikingly well aligned with the drainage of the present Green River Basin. The apparently reversed drainage of the upper Rockcastle Basin suggests that it may have belonged to the Kentucky system before the upwarping, possibly discharging through the Dix into the Kentucky. Further field work in Rockcastle county is required before it is known whether the peculiar drainage and surface features of that section are the result of piracy by the Cumberland.

To the Cumberland therefore was assigned the major role of expansion during the second erosion period, as the result of which the southeastern counties of the Pennyroyal acquired an orientation of ridges and valleys that is distinctly disharmonious with the rest of the region.

The Third Erosion Period

After the drainage basins developed approximately to their present plan the processes of degradation continued to reduce each of these basins until all the larger streams and many of the minor ones were at grade, flowing in very wide and almost certainly in very shallow valleys. A meandering habit is extraordinarily characteristic of the streams in most sections of Kentucky. Miller says that meanders in Kentucky "are so common that in general there is nothing noteworthy about them."[4] These meanders are however, for the most part intrenched, the present stream courses lying in many cases two or more hundred feet below the level of the smooth upland. At the upland level may be seen in many places the remnants of old fluviatile deposits of gravel or sand, separated by hundreds of feet vertically and by an interval of many thousands of years

[4] Geology of Kentucky, Ky. Dept. of Geol., Series V, Bull. 2, p. 221.

from the present stream levels. The very sinuous courses of the rivers of Kentucky and of adjacent states of the Upper South constitute the most remarkable area of intrenched meanders in America. On no American river is this feature more symmetrically developed than on the Cumberland. The meanders

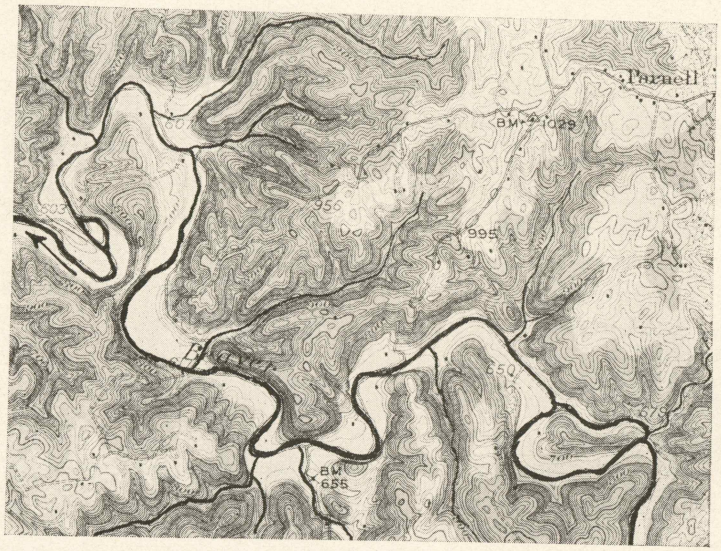


FIG. 6. A MEANDERING STREAM.

are not related ordinarily to jointing, nor to geologic structure. They are developed on a variety of rocks and are accompanied characteristically by high-level pockets of sand and fine gravel. They owe their origin therefore to the uplift of a surface over which streams once wandered in broad flood plains.

This uplift initiated the last erosion cycle, which is still continuing. The meanders were developed in the second cycle, but they lie in valleys of the third. As the land was uptilted the streams cut down their beds and at the same time they cut vigorously against the outside of the meander loops, thus enlarging the radius of the meanders. The result is that there are characteristic, long slip-off slopes leading from upland to bottom on the inside of the meander bends and that there are crescentic cliffs on their outside. On the Cumberland the meander loops

in several cases have attained to a length of fifteen miles. In some cases the loops have become cut off in the process of their incision and now form conical hills, sometimes miscalled "Indian mounds." Some of these cut-off cones are still surrounded by flood plain, in others the abandoned valley has become a terrace. One advanced form, nearing the cut-off stage is shown in Figure 6. The connecting cedar-clad ridge has been narrowed to the width of a wagon-trace, and from it the land falls away abruptly on either hand to a broad flood-plain.[5]

The nature of the Cumberland Valley as a human site is so largely expressed by the succession of great meanders, that this feature is stated in detail and illustrated in a later chapter.[6] We may here direct attention to two of its features, of particular significance to physical history: (1) Near the top of the present valley, but below the general upland level, are fragments here and there of a fairly well-defined bench. This bench is generally not more than seventy-five feet below the flat-topped upland. It has no connection with a particular bed of rock. Its inner margin forms a sharp concave contact against the upland. It appears therefore to be an old river level. (2) Almost throughout the length of the Cumberland Valley in the southeastern Pennyroyal, and extending down-stream beyond Nashville, are patches of high-level gravel and sand. These consist of small, yellowish quartz pebbles and coarse sand, in beds rarely more than six feet thick. Some of them were sufficiently extensive to have served as Indian burial grounds. They are situated on top of the river bluffs or at no great distance back therefrom. Their persistence in linear distribution and at elevations of 250 to 300 feet above the present river points to a former position of the Cumberland little below the level of the upland. The material appears to be derived from the conglomerate and sandstone of the Mountains. Very similar deposits as to material

[5] A well-known meander is the "Narrows" of Pitman Creek, northwest of Greensburg, regarding which Collins has the following account: "A bend of the creek at this point includes an area of some 200 acres of land. At the narrows, or neck, of the bend, there was but little more room than for a wagon-way, hemmed in on either side by great precipices. In the year 1826, Doctor N. H. Arnold cut a channel or canal across this neck, and erected a mill." History of Kentucky (1877), p. 295.

[6] See Chapter VI.

and position may be seen along the Kentucky River in the Bluegrass, as well as on other streams.

Upland Surfaces Correlated with Erosion Periods

The first erosion level has been destroyed almost completely. The Green River Knobs and associated hills have been shown by Shaler and Miller to be Coal Measure remnants, and were construed as demonstrating the former extension of these beds across the area.[7] They appear to be moreover reduced monadnocks of protected location, belonging to the oldest land surface. Some of them are still capped by sandstone of the Coal Measures, others merely by a sandy waste on limestone. Mostly these monadnocks lie to the north of Green River, but they are not unknown to the south thereof.

The second erosion level has produced the general upland surface of the region, sometimes called the Highland Rim Peneplain. Its surface slopes down toward the west, cutting evenly across the areas of outcrop of cavernous and shaly limestones. In Pulaski County in particular, where minor folds bring to the surface first one and then the other formation, the lack of relation between rock outcrop and elevation of land surface suggests beveling of a surface through peneplanation. Here it is not unusual to pass from one formation to another in traveling along a ridge top, without any notable change in surface. On such an upland the formational difference may be noted only by solution pits and by the change in soil character. A similar condition exists in parts of the northwestern margin of the Pennyroyal, where in places a common upland level extends across cavernous limestone and the much more resistant sandstone. Such conditions of uniformity of surface over strongly differing rock materials suggests that the even-topped ridges and flats of the interstream uplands are still little modified portions of the Highland Rim Peneplain.

Differentiation of Surface in the Present Cycle

The present erosion stage has been under way sufficiently long so that flood-plains are found not only above the larger

[7] loc. cit., pp. 200, 201.

streams but in lesser measure in most of the creeks as well. The old erosion level is being reshaped by the complex drainage system, sketched above, which is attacking the old surface with varying success according to the materials of which the surface is made. The uniformity of the older land surface is therefore giving way to diversity. (1) The meandering river courses, on incision, have stimulated the dissection of the adjacent upland by tributary drainage, the base from which the tributaries extend back being not a single, fairly straight line, as with most valleys, but the whole meander belt, several miles in width. (2) In the cavernous limestones the drainage is still primarily underground. Surface streams here therefore are primarily the master streams, of early origin. (3) In the shaly limestone and sandstone country small surface streams are abundant, combined into highly dendritic patterns. Here the surface for many miles back from the master stream is likely to be a complex of neatly interlocking ridge-spurs and valleys.

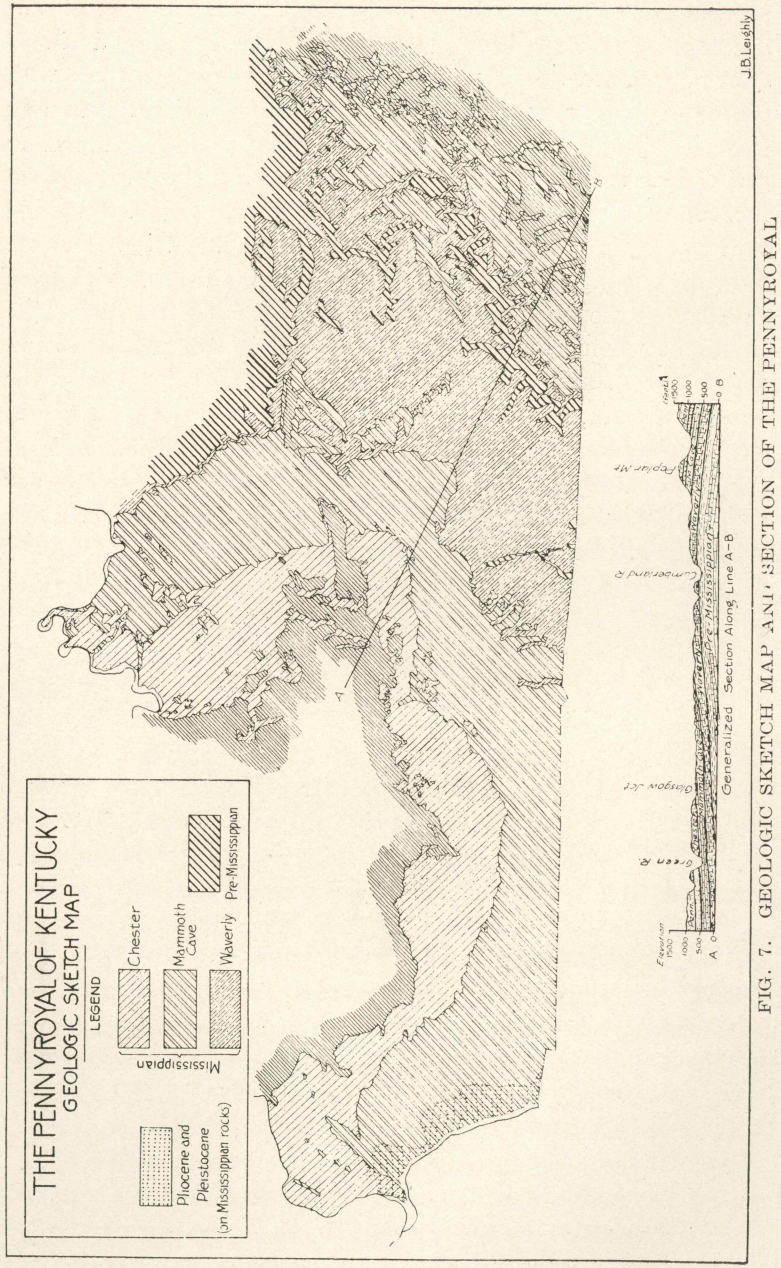


FIG. 7. GEOLOGIC SKETCH MAP AND SECTION OF THE PENNYROYAL

CHAPTER FOUR

NATURAL SUBDIVISIONS: THE CENTRAL PENNYROYAL

Physical Area in the Pennyroyal and its Relation to Rock Formation

A simple sequence of sedimentation in the geologic history of central Kentucky has been the basis of the major diversification of the present surface. The following geologic facts will aid in understanding the geography of the area: (1) The basal beds locally exposed are predominantly shaly limestones (mostly Waverly series), the result of an extensive shallow sea in Mississippian time, favorable to the accumulation of beds of mud and shells. (2) Thick-bedded, quite pure limestones lie above the basal members. The Mammoth Cave series, in its full thickness amounting to several hundred feet, is the middle of the local stratigraphic section. (3) The limestones were covered by sandstones with some limestone and shale, as the result of the gradual withdrawal of the sea. The formational term Chester covers the greater part of these topmost rocks of the Mississippian period. (4) The upwarping of the Cincinnati Arch and the down-warping of the Western Coal Basin determined the major structural disposition of the beds. It is convenient in the following geographic description to employ these geologic facts and terms, since it happens that each of the three principal formations of the Mississippian system has lithogic unit locally and therefore surficial distinction.

Figure 7 shows the following surface distribution of the major rock formations: (1) Along the Cumberland and its tributaries, in lesser measure on some of the headwaters of the Green and Barren rivers, the bed rocks of the Lexington and Nashville basins and their margins (Silurian, Ordovician, and Devonian limestones and shales) are exposed in narrow belts, where streams have sunk their channels deeply across or along the central part of the arch. (2) The shaly limestones of the Waverly series form a broad outcrop, elongated from northeast

to southwest, the general upland surface in the Pennyroyal section of the Cincinnati Arch. (3) The normal limestones of the Mammoth Cave series form a narrow belt of land between the Mountains and the Waverly surfaces and also a very much larger surface to the west of the arched area. (4) The sandstones of the Chester series lie in a rudely crescentic area about the Coal Basin. (5) Small bodies of the massive Pennsylvanian sandstone are found as outliers in conspicuous knobs here and there through the Pennyroyal.

The physical features of the area are developed primarily out of these rock materials, drainage features being the principal exception to the control by geology of the physical landscape. Lithologic boundaries therefore serve in general as boundaries of the natural subdivisions of the region. Where geologic derivation has been as prepotent as in Kentucky, the recognition of natural divisions is quite simple. In the recognition of natural divisions, however, at least three additional considerations must be taken into account: (1) In the Cumberland Valley the physical individuality of area is the joint result of an elaborate intrenchment of a great meandering system and of the exposure of particularly weak shales and of readily soluble limestones. (2) The interfluve area of the lower Cumberland and Tennessee derives its individuality primarily from the very intricate dissection of the adjacent land. (3) A unit area has continuity. Detached bodies of one formation, such as the Mammoth Cave, flanked by other formations, may be physically and functionally differentiated. There are in fact three physically distinct, detached bodies of Mammoth Cave surface. In detail the appearance of the area is further differentiated from section to section by more complex conditions as set forth in the following chapters. The reader is asked to refer back to the diagrammatic map and the geologic sketch map for the understanding of the following sections (Figures 4 and 7).

The Cavernous Limestones

Of greatest importance in determining the physical geography of the area are the cavernous limestones, to which Miller has applied the expressive name—"Mammoth Cave." These

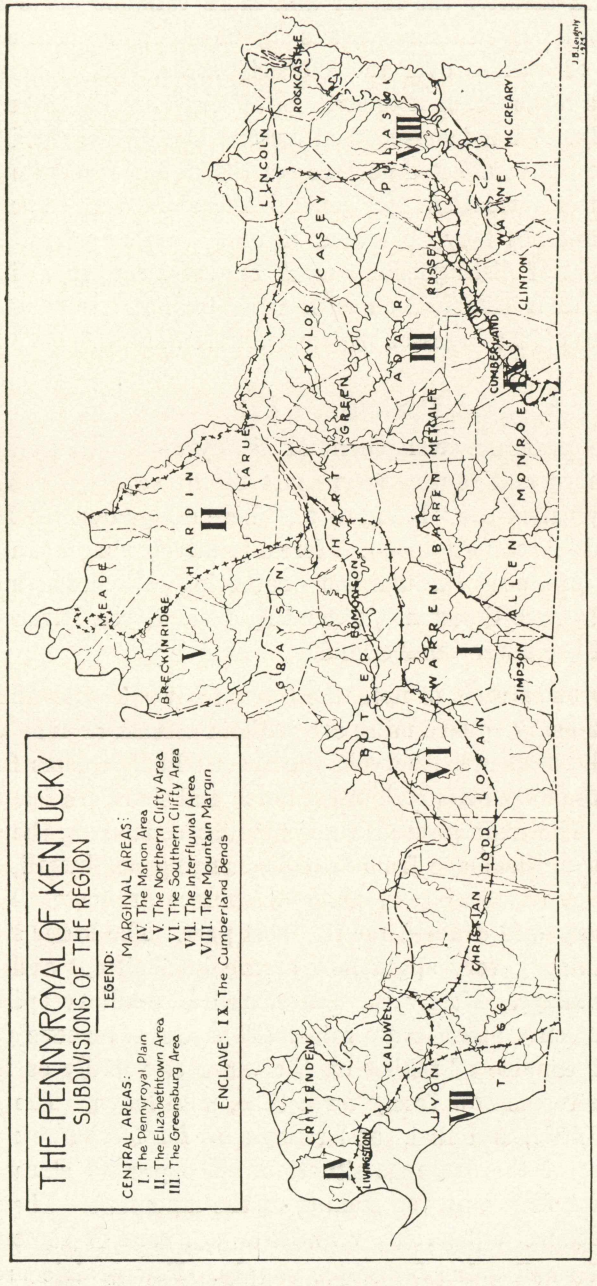


FIG. 8. SUBDIVISIONS OF THE PENNYROYAL.

rocks form directly the larger and more valuable parts of the Pennyroyal. Even their waste is significant in the character of soil and of surface over the Waverly areas, that is in places where the rocks of the Mammoth Cave series have been removed completely. Their honeycombed masses, underlying the Chester sandstones, have affected surface conditions in areas of outcrop of the latter formation. In general, therefore, the influence of these limestones may be traced throughout the region. They form a sort of distinguishing mark for the Pennyroyal in general, and their combination with other local determinants furnishes one of the bases of physical differentiation.

The Pennyroyal Plain Area

The optimum development of Pennyroyal conditions is in the southern and southwestern part of the region, in the area popularly called the "Pennyroyal," here designated the Pennyroyal Plain Area (Figure 8). Here a relatively simple landscape has been produced through the weathering of a broad mass of Mammoth Cave limestones, extending from Green River to the breaks of the lower Cumberland.

Only one stream of note, the Barren River, crosses the area. Tracts of many square miles are without stream or true valley. Mostly the area is a reservoir site from which streams flowing through the hilly belts both to the north and south are fed underground. The underground water parting, separating the southward moving drainage from that discharging northward, is not disclosed by any surface ridge or by surface drainage. Yet the land is very well drained for the most part. The lesser streams have ordinarily very slight flow or are intermittent and lie in shallow valleys. Mostly these streams are auxiliary spill-ways significant only after heavy rains. Then the cavernous ground may be incapable of taking up the water as rapidly as it falls and the streams flow freely for a time, mud laden. The names Muddy, Little, and Red, used repeatedly for local streams, are expressive of the drainage situation. The present streams are very minor factors in the making of the landscape. They have no significance as barriers, very little as means of communication, and small value for water supply. Few prairie areas of

the northern states owe less of their physical expression to the work of present-day streams than does this country.

For the most part the surface is strikingly smooth, and the region is well called a plain (Figure 9). Rock outcrops are

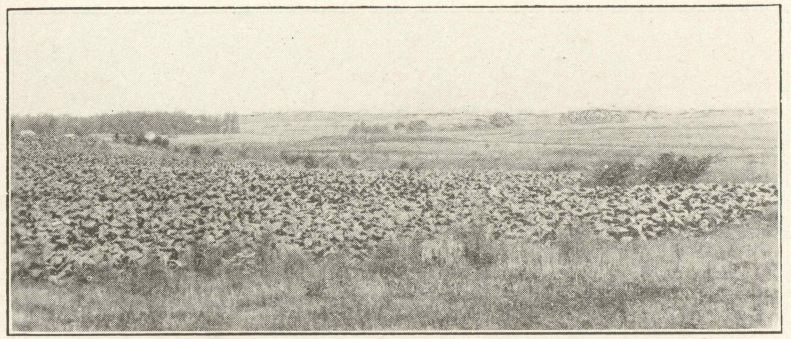


FIG. 9. PENNYROYAL PLAIN SURFACE.
This region is south of Hopkinsville. A small stream lies in the center of the view.

rare, except at the northern margin of the area, but bed rock ordinarily is encountered at a depth of from two to fifteen feet (Figure 10). The limestone does not furnish a great amount of residual debris on weathering. It is also so well broken across by solution fissures that much of the weathered material is washed down into the cavernous passages and carried out of the area. The development of present surface and soil is essentially

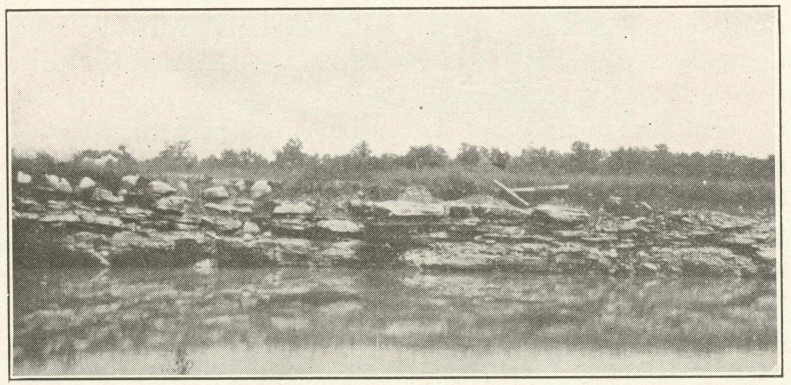


FIG. 10. QUARRY IN SMOOTH PLAIN SOUTH OF HOPKINSVILLE.
The land adjacent is cultivated and highly productive with about the same depth of soil as shown here.

the work of solution and underground drainage. The effectiveness of such drainage is suggested by the fact that this smooth plain, with approximately fifty inches of rain annually, and a clay loam soil, dries off more rapidly than the average Iowa or

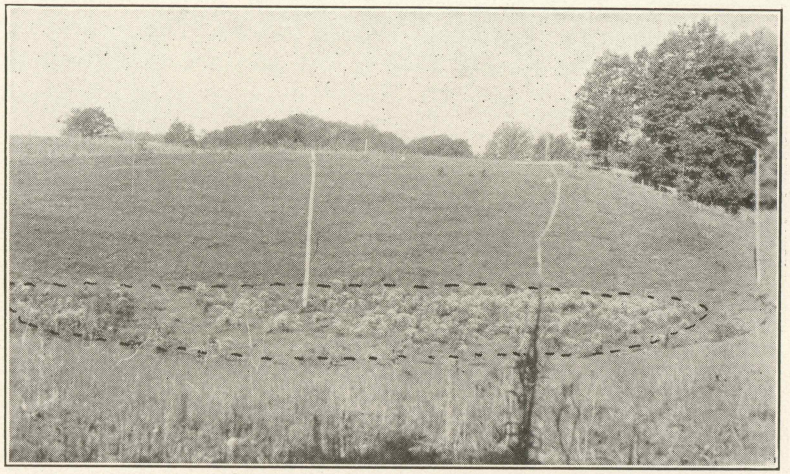


FIG. 11. SINK SOUTHEAST OF BOWLING GREEN.
The dotted line encloses the floor of the sink.

Illinois prairie. The activity of solution is so evenly distributed that the surface is being let down very uniformly, the water descending through a sieve-like rock body.

Sinks are recognizable, but are so shallow that many of them cannot be reproduced by photograph. Figure 11 is from one of the more uneven sections of the Pennyroyal Plain and represents relief of sink topography (note telephone pole) far in excess of most of the area. Only a very small percentage of the sinks show rock outcrops. In many of them the soil is of about the same thickness on slopes and floor. The most conspicuous solution features are in the vicinity of the Green and Barren rivers, and are largely represented on the Bowling Green, Mammoth Cave, and Brownsville topographic sheets. Miller suggests properly a relation between size of stream and frequency of solution forms in the upland.[1] Solution depressions of large size and considerable depth require a vigorous discharge of un-

[1] loc. cit., p. 198.

derground waters into valleys well below the surface of the solution area and usually also a resistant capping rock. Near the Barren and Green rivers the vertical range of active solution is at its maximum for this area. Here also a considerable local

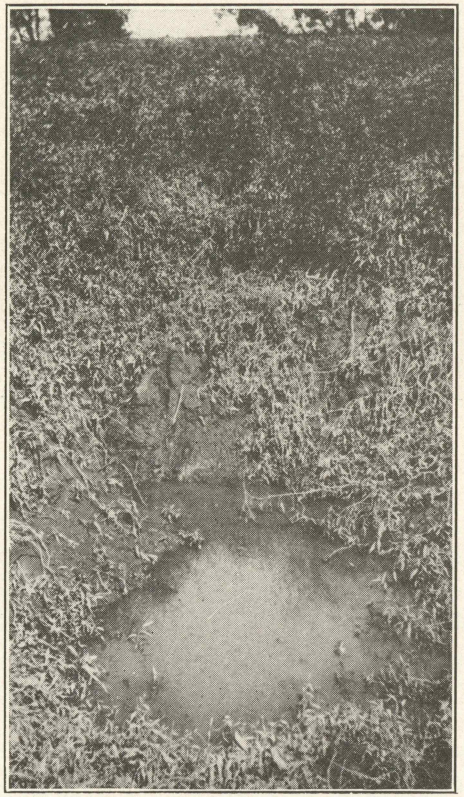


FIG. 12. SMALL RECENT SINK.
It is located four miles south of Hopkinsville on the Henry farm. The sink has been formed in the last two years.

variation in solubility of limestone beds provides a certain measure of retaining wall. Though the sinks near the Barren are usually not more than thirty or forty feet deep they are relatively narrow and in places form a pitted surface of small value.

Over the greater part of the Plain the solution depressions have very gentle slopes. Occasionally one sees a small abrupt

sink (Figure 12), usually of most recent origin. The minimum water table under this area is not more than fifteen to twenty feet below the surface. The vertical range of effective solution is small. A rather even deliquesence of the limestone is taking

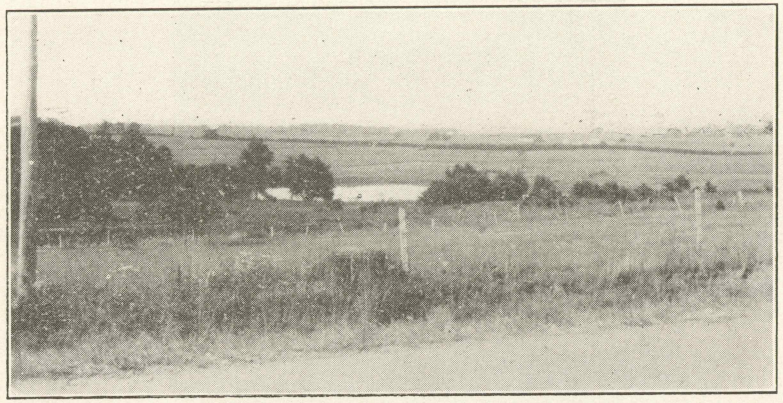


FIG. 13. ON LINE BETWEEN TRIGG AND CHRISTIAN COUNTIES.
This view is east of Cadiz, a Pennyroyal Plain Surface, with characteristic shallow pond.

place without opportunity for the formation of any great cave-ins. These depressions probably represent primarily solution along joint or vertical fracture planes. The entire present landscape is therefore essentially the result of solution, even the remarkably smooth areas of Simpson, Todd, and Christian counties containing innumerable slight swales. Small ponds are numerous. (Figure 13.) Some of these existed prior to the cultivation of the area. Mostly, however, they are solution depressions that have become blocked by the wash of soil and other detritus into them from surrounding cultivated fields.

In some sections the Pennyroyal Plain is further diversified by detached elevations, reminiscent of the topography of the Nashville Basin, studded with small remnants of more resistant rock. This condition in the Pennyroyal Plain is especially true of the vicinity of Russellville, where low, rounded hillocks (Figure 14), usually chert covered, represent remnants of a harder cap rock that once extended across the area.

The most divergent surface conditions of the area are found in the Bear Wallow Hills of northern Barren County, developed

on the same limestones as the plain, but rising in their highest portions approximately to the height of the sandstone ridge on the west of the plain, however with notably less steep slopes. These hills are partially dissected by surface drainage but con-

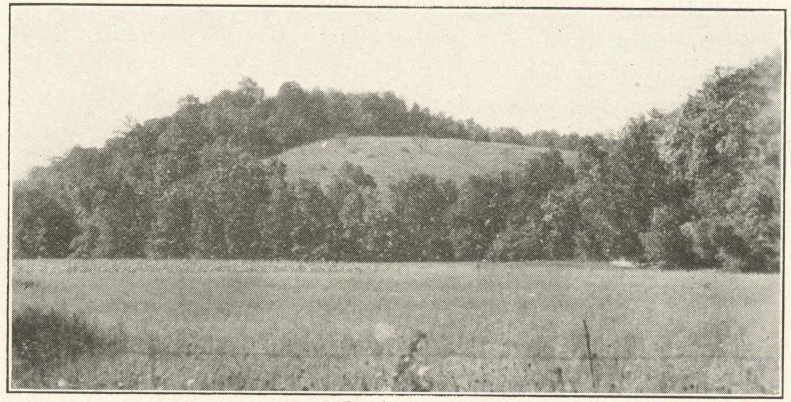


FIG. 14. CHERT-COVERED HILL.
This view is characteristic of the Russellville vicinity.

tain also many surface features of solution more notable than in the plains area.

The upland soils of the Pennyroyal Plain show minor variations in accord with lithologic differences. Where chert and argillaceous materials are interbedded with the limestones they give rise to a stony, clayey soil of lower fertility than that formed by the weathering of the normal limestone. Along the northern margin of the plain there is in places an admixture of sand which seems to be residual and to have been left over from the sandstone cap that now has retreated to the north and west of the plain.

Over the larger part of the area, however, the local variations in soil result primarily from different modifications of essentially uniform rock material. The usual upland soil is a rich brown silt-loam, often chocolate colored. This surface soil below the plow-sole merges into a red clay sub-soil. The surface soil is usually in excellent physical condition, well drained and well aerated. It is well supplied with mineral plant food, though

deficient in readily soluble phosphorus,[2] fairly well supplied with organic soils as southern upland soils run, and not strikingly deficient in lime. The soils of the central Bluegrass exceed those of the Pennyroyal Plain in productivity only because of their higher phosphorus and lime content.

On slopes the surface soil tends to give way to the finer-textured sub-soil. The red clay, everywhere present, may be said to outcrop only on plowed slopes; the redder the land, the thinner the soil.

The soil material washed from the slopes is carried into depressions and deposited in them, forming level floored basins. This washed-in material is usually not clayey, but silty. In color it resembles the upland soil from which it is derived in the main. The silted areas are inadequately drained, water ordinarily standing on them after rains. Their mottled sub-soil is indicative of poor drainage.

In basins which have been silted in for a long time the soil has gradually been leached. The soluble materials are mostly removed and the soil particles reduced in size until the soil is a tight, grayish clay, usually called "crawfishy." The sub-soil may be almost impermeable and contain iron concentrations. The "lake" flats or "flatwoods" are commonly wooded. Sedges and other acid land growths are conspicuous in the ground cover. They are part of the common type of upland swamp of the South, a climatic expression of rather permanent character, producing a soil of low agricultural attractiveness. In this area their extent is not large, probably not in excess of two per cent of the total area.

Type Section for Pennyroyal Plain

The type section (Figure 15), at Masonville, six miles south of Hopkinsville, is representative of the best of the Pennyroyal, but fairly typical of the Pennyroyal Plain generally. Most of the surface is very gently billowing upland (Figure 16) of high productivity. Here and there a small, brushy sink breaks the continuity of the fields (Figure 17) and a few filled basins have been allowed to remain in a tangle of trees, brush and

[2] Ky. Agric. Exp. St. Bull. 193.

rushes. (Figure 18.) The maximum relief of the area is only about thirty feet, and excepting one rock slope on the edge of the eastermost basin, virtually the entire surface may be cultivated.

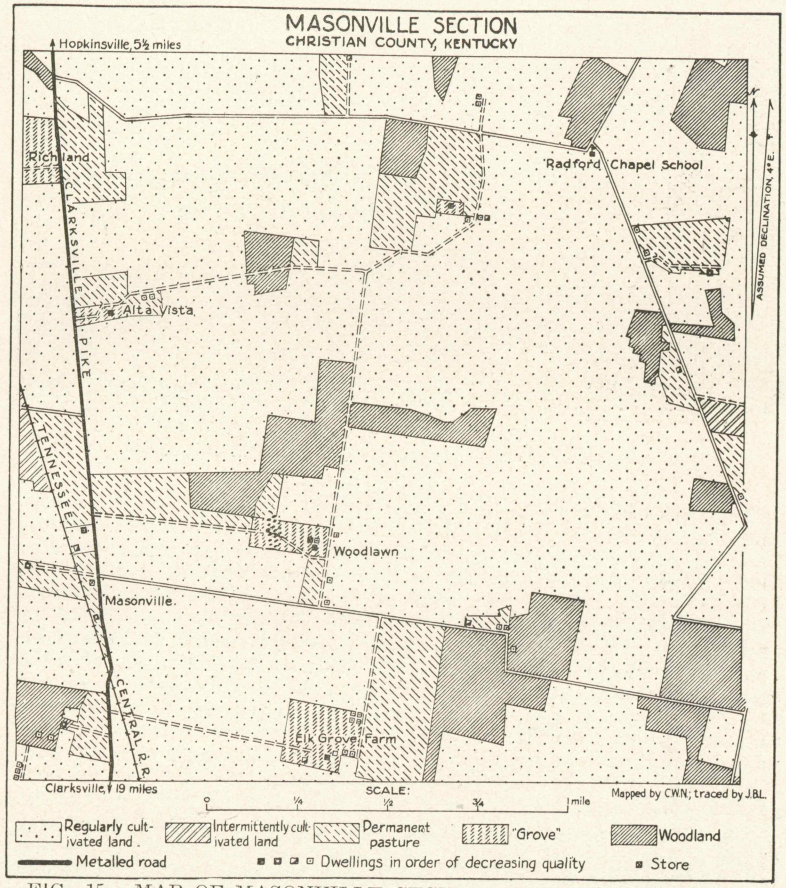


FIG. 15. MAP OF MASONVILLE SECTION, CHRISTIAN COUNTY.

Explanation of the features shown on the map.

1. Silt Loam Upland. A rich brown silt loam of varying chocolate shades lies on well drained areas of slight to moderate slope, the normal surface and soil of the section. The dark color is indicative of humus content, good aeration, and good drainage; the silt loam texture is the result of the washing downward into the sub-soil of the finer materials. The soil has a fair lime content but is deficient in readily soluble phosphorus. It is a fertile, readily worked soil, but to considerable extent it has not been accorded the intelligent care which it requires and well deserves. The soil responds well to proper treatment,

and the good drainage and generally moderate slopes are valuable assets.

2. Red Clay Slopes. Beneath the surface the brown silt loam becomes finer in texture, more compact, and redder in color and merges at a depth of twelve to fifteen inches into a distinctly reddish clay loam

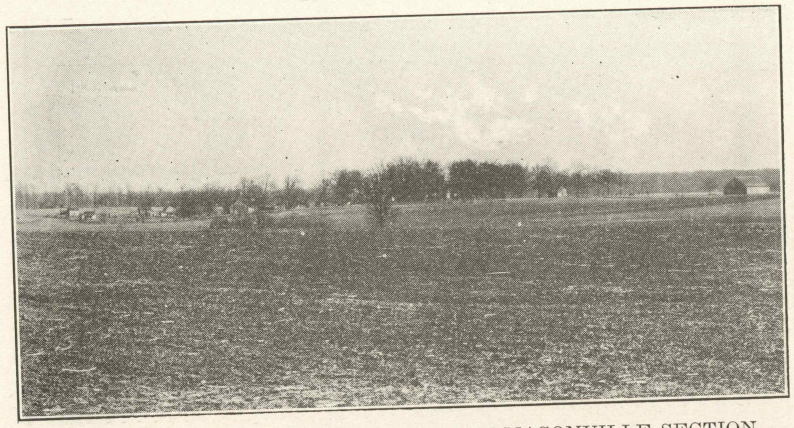


FIG. 16. GENERAL VIEW OF UPLAND IN MASONVILLE SECTION. This is one of the superior farming regions in Kentucky.

or clay sub-soil. On the less gentle slopes, especially under cultivation, the surface soil tends to be carried away by slope wash. Where wash is excessive the red clay sub-soil is exposed and forms the surface. Such areas are irregular in form and distribution and small in extent. Nearly all red clay soils of the section have been exposed since clearing and cultivation began. Near the southeast corner of the section is a notable example of moderate slopes which have been excessively washed on the cleared fields, while in the woods adjacent the same slopes retain their original darker-colored, coarser-textured surface soil. There is a prevalent belief that the red clay is more fertile than the brown silt loam because of its more recent origin and nearness to the limestone underlying; it is also considered a stronger soil. It seems doubtful that this soil is actually more productive under comparable conditions.

3. Silt Floored Depressions. The material washed from the slopes is deposited on the bottoms of the solution depressions so that they are smoothly-floored by a thick silty soil resembling the upland soil in color and texture. It is usually more reddish than the upland soil and rather more irregular and seemingly coarser in texture. Such soils are very productive when properly drained; otherwise crops planted on them are apt to be drowned out or have an excessive growth of leaf.

4. "Crawfishy" Flats. Where it has remained for a very long period under conditions of poor drainage the silt floored depressions have become leached of their soluble mineral constituents and the soil particles are reduced to a very fine state. This compact, very fine textured soil becomes gray or even whitish when dried out. It is distinctly acid so that only sour land growths occur on it. The silt floored depressions may be considered the recent representatives of

the older flats of gray, crawfishy soil. The silt floors have been formed principally since the beginning of cultivation facilitated slope wash. The gray clay flats were in existence at the time of settlement.

5. There is in the Masonville Section, as in many of the smoother portions of the Pennyroyal Plain, a very small amount of land too

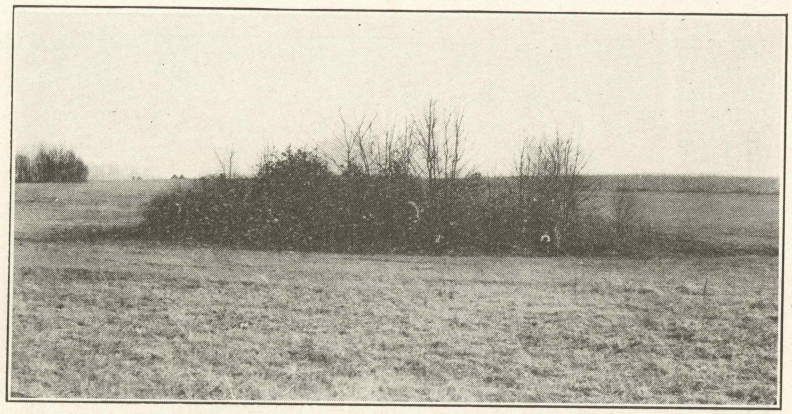


FIG. 17. ONE OF THE FEW SINKS IN THE MASONVILLE SECTION.

rocky or too steep for cultivation. Such rocky slopes occur occasionally along the valley walls of a shallow valley or on the slopes adjacent to a solution depression, as shown on the east edge of the section map. Such slopes are ordinarily left wooded or in pasture though crops may be grown on some of them occasionally. The only other steep slopes of the area are those of the narrow, though shallow limestone sinks. These sinks are so small and scattered in the section that they interfere little with cultivation though occurring in fields.

The Elizabethtown Area

Going south from Louisville one skirts the edge of the Bluegrass for a few miles, until the valley of the Rolling Fork or of the Salt River is reached. Beyond these streams lies the Knobs country, rough, brushy, poor. Having climbed out of the valley and continuing several miles farther south or west on top of a widening ridge, the country is seen to open out gradually into a broad and pleasant upland, very much unlike the ridge and valley country with its meagre farmsteads that has just been passed. This is the familiar entry into the Pennyroyal from the north. This most northerly section of the Pennyroyal centers about Elizabethtown, its oldest community, and is therefore designated by the name of this place.

The Elizabethtown Area is marginal to the Pennyroyal only in location. In physical character it is a slight variant from the Pennyroyal Plain. There are fewer stretches that are conspicuously smooth and fewer flatwoods. The landscape is in

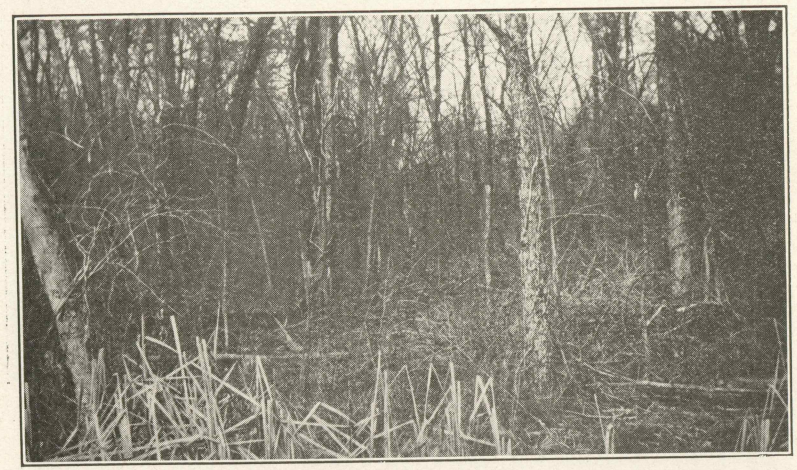


FIG. 18. ONE OF THE FILLED BASINS.
The dense stand and small size of the timber in the Masonville section is typical of this site and in strong contrast to normal upland forest.

general rolling (Figure 19), and some of the land is rough. The rich, brownish color of the fields along the Tennessee border is replaced by more reddish tones due to greater removal of surface materials. In places the bright brickreds of the landscape flaunt afar the prevalence of slope wash over extensive areas. The area is derived throughout from the normal Mammoth Cave limestones, primarily by solution and weathering. In contrast to the Pennyroyal Plain, the region is drained relatively freely by or into streams and surface run-off is fairly great.

Few parts of this area are as much as ten miles removed from a major valley. At the north is the great trough of the Ohio, with steep slopes prevailing for half a dozen miles back from the river. The valley of the Rolling Fork parallels the entire eastern margin and from it tributary valleys lead back into the margin of the Elizabethtown area. To the south lies the Green River, and to the west the Rough and Nolin rivers and their tributaries have formed deep valleys. Mostly these streams

do not invade the limestone area with conspicuous valleys. They do, however, provide opportunity for underground waters to move outward to the margins of the area at lower levels than in the district to the south and therefore to form more conspic-

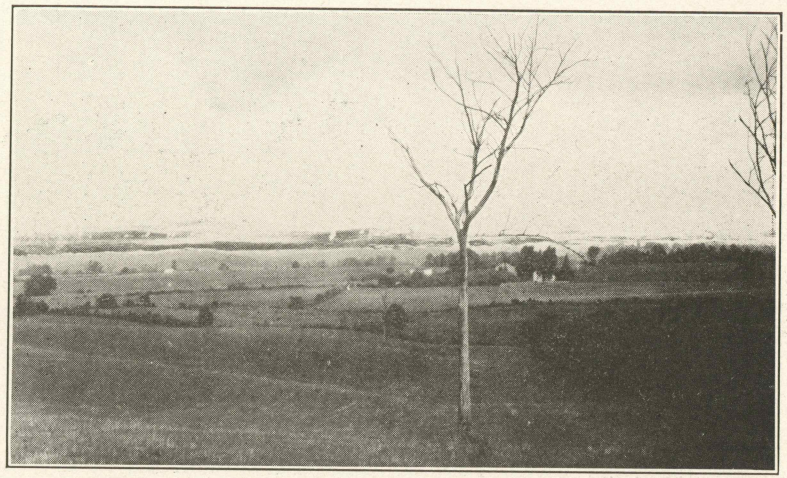


FIG. 19. ROLLING UPLAND NEAR IRVINGTON.

uous solution depressions. In this section for example, unlike the southern Pennyroyal, a very common source of domestic water is from springs issuing at the bottom of well-like sinks. These springs are underground rivulets collected in limestone fissures. The bottom of the sink may be permanently below the water table. Very commonly the sinks are in chains. Such a series of depressions tends to be converted in time into a continuous basin with a small surface stream (1) by the run-off that flows in towards the centers of the depressions and wears their slopes back gradually, (2) by the blocking of sink outlets through slope wash and the consequent overflow after rains from one sink basin to the next lower one, and (3) by the weakness of the cavernous surfaces beneath, and by their continued caving. Semi-alluvial basins are therefore an important part of the local landscape.

The area is further distinguished from the Pennyroyal Plain (1) by its gravitation economically toward the north, especially

toward Louisville, whereas the southern Pennyroyal has business primarily with the Cumberland Valley to the south, especially with Nashville. (2) There is a physical demarkation between the Pennyroyal Plain and the Elizabethtown areas in a strip

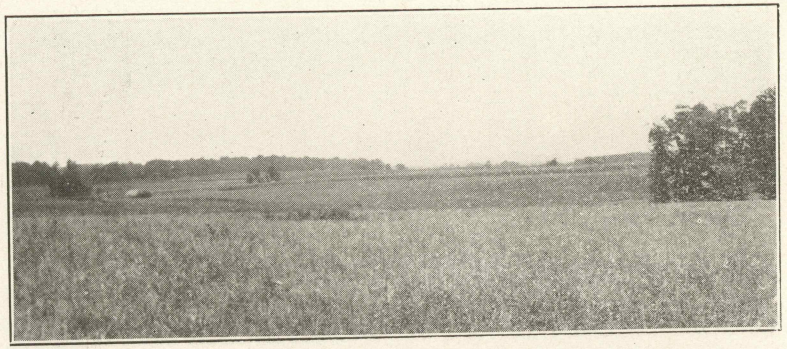


FIG. 21. SMOOTH UPLAND, WESTERN LARUE COUNTY.
This view is in the Lincoln Farm section.

of ridge and knoll country, five to ten miles wide, lying immediately north of the Green River. This is a spur of the sandstone belt to the west. It crosses Hart County and terminates in a tract of rough, high ridges in Green, Taylor, and Larue counties. Quite unlike the surrounding areas, it is a region of long ridge tops, forested slopes, thin, sandy or gravelly soils, and isolated, backward communities. Lacking a descriptive name in common use, this section is here called the Brush Creek Hills. Were it not for its small extent, it would be recognized as a distinct subdivision of the Pennyroyal. Physically it appears to represent a remnant of the Coal Measures sandstone.[3]

Type Section for Elizabethtown Area

The type section for this region is taken from the vicinity of the Lincoln Farm, two and a half miles south of Hodgenville, Larue County. The map of the section is shown in Figure 20. The smoother upland, as illustrated west of the Lincoln Farm in Figure 21, is distinguished only by very minor swales. It is on the whole adequately drained by underground channels, but these have not proceeded to a stage in which they have di-

[3] An interesting account of the origin and nature of this area is given by Burroughs, W. G., A Pottsville-Filled Channel, Ky. Geol. Survey, ser. VI, vol. 10, pp. 115-126.

Detailed Legend of Type Section for the Elizabethtown Area.
Surface features as shown on the map: Fig. 20.

1. Smooth Solution Upland. Surface undulating to gently rolling. On the larger patches, the best land in the area. On the narrower spots in the eastern and northern parts of the map, less productive.

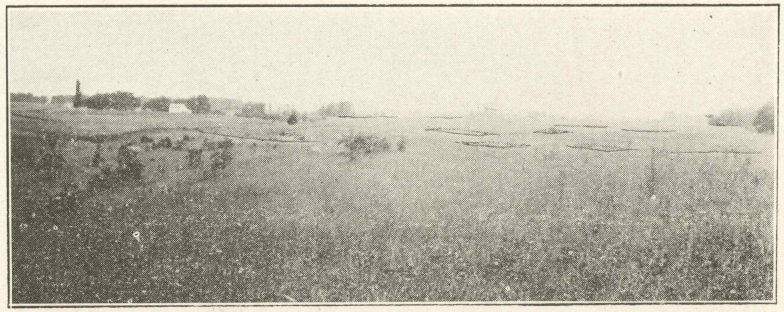


FIG. 22. ROLLING UPLAND OF SECONDARY SOLUTION.
This view is north of the Lincoln Farm.

Soil a silty loam, floury in texture, with some fragments of block chert; in color, grayish brown. The waste of overlying rocks has merely been let down gradually as solution has removed successive thicknesses of the limestone.

2. Secondary Solution Surface. This type consists of the slopes of the minor solution depressions, and of the narrow strips of higher land among them. It represents that part of the surface on which there has been a lateral translocation by surface run-off of the products of weathering, as contrasted with the smooth upland, on which the removal of material has been accomplished wholly by percolating waters. The soil is practically identical with the subsoil of the upland, a red clay loam, containing the usual chert fragments and siliceous fossils of the Mammoth Cave limestones. Run-off on the short, frequently steep slopes has damaged much of the surface by slope-wash.

3. First Bottom. Along the branch of Nolin River, which crosses the southwestern corner of the area mapped, narrow, crescentic strips of flood plain have developed within the meander bends. Though small in areal extent, they constitute excellent farm land. The soil has the familiar character of alluvium, in accordance with the small size of the stream, tending toward a sandy loam in texture.

4. Terrace. In a former cycle of stream action, a flat was formed by the stream at an elevation of twenty-odd feet above the present flood plain. The surface of this terrace is smooth, except as intermittent streams crossing it have eroded narrow gullies back from the edge. The soil is inferior to that of the first bottom, having suffered leaching since the rejuvenation of the stream.

Minor Solution Depressions. The differences among these are discussed in the text. As will be observed on the map, they are most numerous on the secondary solution surface, but are not absent from the smooth upland. They form the outlets for the run-off of the area, the drainways to them being short.

Erosion Damage. Slope wash has been for the most part merely sheet erosion, as the short slopes do not collect large volumes of water, by which gullies of notable size may be formed. The result of

this sheet erosion has been to produce a surface concentration of chert, lying upon the normal red clay subsoil of the region, the latter exposed by the removal of the more silty surface soil. Where the gentler slopes of the upland have been affected, a lowered productivity is the principal manifestation, the process not being sufficiently active to produce

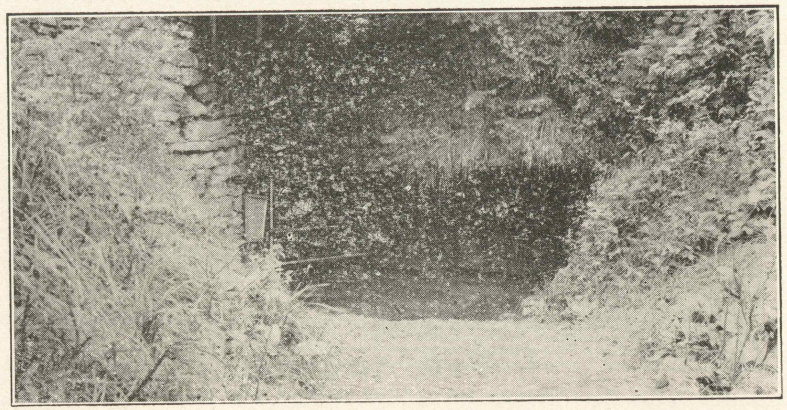


FIG. 23. SPRING IN SINK AT LINCOLN FARM.

the same results as on the less pervious soil and steeper slopes of the secondary surface. Little of the latter type of surface has escaped damage, where cultivated. The areas mapped as damaged represent those parts where the injury has been sufficient to affect utilization to a notable degree. Where the surface is forested, the soil has naturally escaped; and much of the blank area on the map is to be referred to the protection afforded by forest cover.

versified the surface conspicuously. Between the smooth uplands lie lower areas, where solution has produced a topography extremely complex in detail. This secondary solution surface lies on the average twenty-five to fifty feet below the former surface, and joins the latter by a fairly well recognizable, though not abrupt rise. A view of the second surface, directly north of the Lincoln Farm, is shown in Figure 22. This secondary surface is really a series of major depressions, reduced from the higher surface, with an intricate pattern of sink bottoms and interjacent short ridges. Although appearing smooth at a distance, most of this land lies in slopes which are too steep to retain their soil cover when subjected to careless tillage. Under cultivation, most of these slopes have been eroded to some extent, and many have gone out of agricultural use.

The minor solution depressions, which give distinctive geographic expression to the area, are of several forms, which are, however, successive stages in development of one series of forms. The primitive form is the sink (see map), which represents the

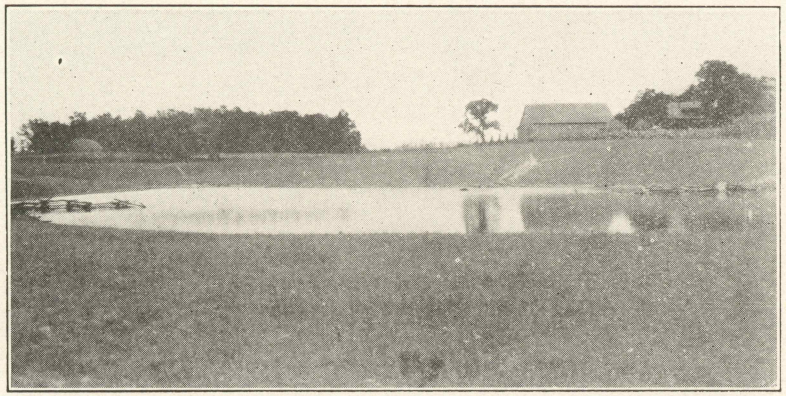


FIG. 24. POND IN SINK.
This view is situated in the Lincoln Farm section, northwest of Lincoln farm.

means of escape to successively lower levels of the run-off, either from the surface or from a higher to lower bedding plane in the limestone. It is the latter form of drainage that gives rise to many of the springs of the area, local appearances in the sinks of minor lines of underground drainage, from which the water continues underground to still lower levels. Such a spring on the Lincoln Farm is illustrated in Figure 23. At the time of settlement, such springs were numerous, and determined the location of most of the dwellings. With the clearing of land and the cultivation of the slopes, most of the springs have been clogged up by the continued inwash of soil material, and have become marshy spots or ponds. Such ponds are conspicuous features of the landscape, and represent a second, largely culturally induced form of solution depression (Figure 24).

Where the slopes adjacent to the ponds are cultivated, or have been abandoned without adequate plant cover, the deposition of soil material continues, and gradually displaces the water occupying the bottom of the depression. On the map may be seen several depression, partly occupied by water, in which the

process of filling is only partly completed. The so-called "basins" have been formed in part in this manner. These flat-bottomed depressions did exist in part prior to settlement, but settlement has greatly augmented the amount of soil wash and therefore

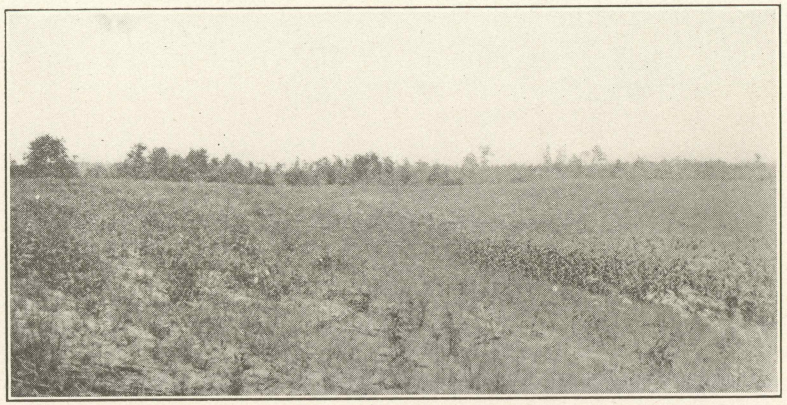


FIG. 25. AGRICULTURAL CONTRASTS.
This cultivated basin floor and its abandoned basin slopes are in the Lincoln Farm section.

the filling and horizontal extent of the basin floors. The flat surface of the basin floors makes these features of particular significance, since in the secondary upland surface they are almost the only parts not subject to soil erosion. It is not uncommon to see the basin floors alone cultivated, the slopes armored with chert fragments or furrowed by gullies, being abandoned to blackberry briers and sassafras. Figure 25 shows at the right a basin floor with its usual corn field. The rest of the scene is of worn-out slopes.

In the emergence of the most advanced stage of solution surface, the basins are largely filled, the intervening ground is much reduced in height, and the individual depressions tend to coalesce. These events have given rise to the elongated, irregular plan of the larger basins. These basins have the general appearance of shallow valleys (Figure 26). They may have stream beds or lack this feature. The drainage is to the lowest spot, which may be at one end or toward the center of the basin, where the water collects in a pond or small marsh, thence, to sink to some subterraneon outlet.

Each of the surface forms described has its characteristic soil. On the upland, unaffected by soil erosion, the downward migration of the finer soil constituents has concentrated the coarser residum of the limestones in the surface soil, and has

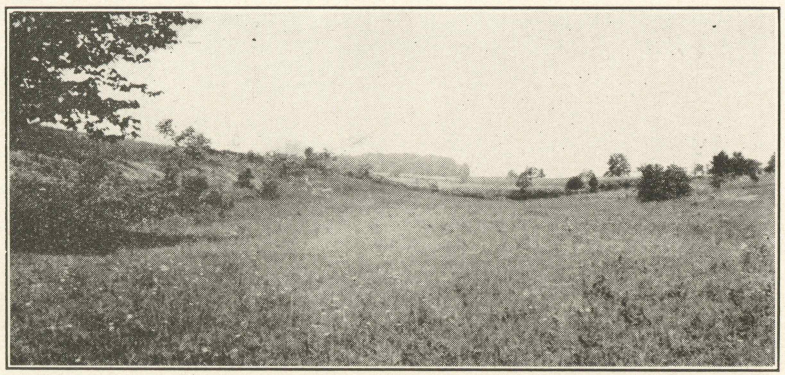


FIG. 26. VIEW DOWN AN ELONGATED BASIN
This is in the Lincoln Farm section.

given to it the character of a silt loam. The material on the basin floors is a mixture of silt washed from the upland and of clayey soil from the slopes, commonly a clay loam. It is on the slopes that the soil of finest texture is found, where slope wash has exposed the normal sub-soil of the upland. The finer soil particles tend to be concentrated downward, or in other words to predominate in the sub-soil. Thus the sub-soil is notably heavier than the surface soil.

The fine texture and consequent impermeability share with irregularity of surface the responsibility for slope wash, characteristic of much of the surface after cultivation. Soil wastage on slopes has exceeded soil accumulation in recent years and these are now in large part unmistakably worn by sheet erosion (Figure 25). Poor pastures and clumps of brush make conspicious the distribution of these worn spots throughout the landscape. Slope wash has resulted in more and more discontinuous, irregular, and scattered plowed fields and in a cultural landscape that looks ragged and patchy and in places, forlorn. Man, unfortunately, is an increasing active agent in the physical modifica-

tion or this area, probably the most important of all forces now operative.

Three scenes from the birthplace of Lincoln are given here. Figure 27 shows a detail of the farm, characteristic of the clay

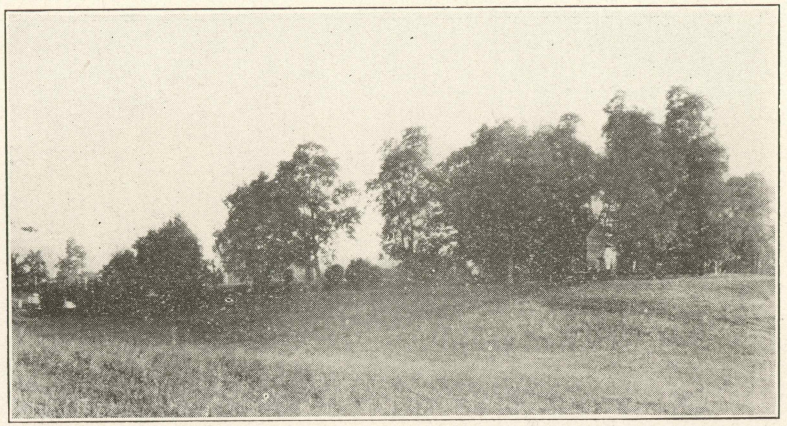


FIG. 27. CLAY SLOPE OF SINK BASIN ON LINCOLN FARM.

sides of the sink basins. The Lincoln farm itself was located mostly on the irregular secondary solution surface. Cultivation has ceased since the land became a public memorial and the place therefore has more the appearance of the landscape in its natural condition than is common for the rest of the area. The pleasant, park-like prospect of the lower part of the farm is therefore suggestive of conditions as they may have been when the area was first brought under cultivation. The lapse of a century of farming has undoubtedly made apparent the ephemeral value of these pleasantly rolling slopes in a manner that was not evident to the first generation of farm settlers. Figure 28 is a view across a small, elongate basin, beyond which the Memorial is built over the site of the Lincoln cabin. The Memorial stands on the secondary solution upland, the stairs lead down the side of the sink basin. At the left of the stairway a clump of trees conceals a sink-hole, with the spring figured above. (Figure 23.)

The Greensburg Area

South of the Green River and about ten miles east of the Louisville and Nashville Railroad the landscape undergoes a

change, which, although far from striking to the casual observer, is none the less positive. The familiar short undulations of the Mammoth Cave surfaces are lost, the change ordinarily taking place within a few rods. The land to the east is not noticeably

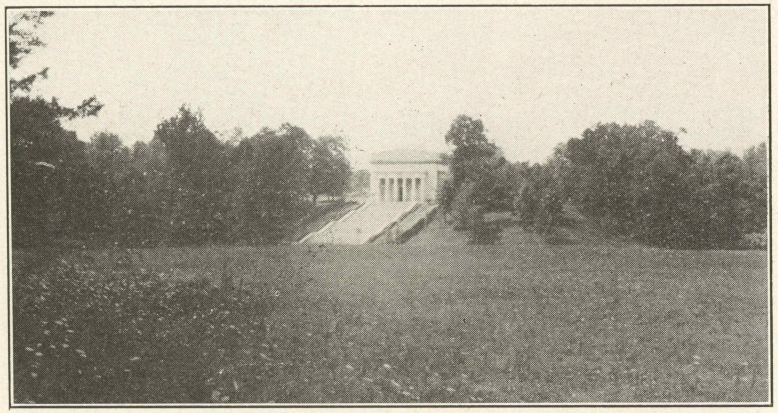


FIG. 28. MEMORIAL ON LINCOLN FARM.
This view is across sink basin to the stone building, constructed over the log cabin on its original site.

higher, but its surface is distinguished by long horizontal components. There are long, relatively flat-topped ridges between which streams fall away in deepening and widening valleys. The brick and maroon reds of the subsoil to the west are wanting and in their stead the ditches and road cuts are in umbers and ochers and the surface soil is lighter, and much less warmly toned. In dry weather the ground has predominantly a grayish to whitish appearance. In places yellowish, knotty geode balls lie on the surface in number. The annular plates of crinoid stems are also abundant at the surface. Several valleys are almost everywhere in sight from the upland, their slopes mantled by a dense growth of forest, with oak, hickory, and beech predominating. Still farther to the east, toward the Cumberland, the upland becomes a series of rugged ridges, occupying at the last end of the area less of the surface than do the valley "breaks." This whole region is underlain by the Waverly formation, shaly limestones of low lime content and solubility. The surface is affected only in slight measure by solution, predominantly it is a portion of

the old peneplain that is being largely remodeled by slope-wash and streams.

Figures 29 and 30 show characteristic views in the central part of the area. The former is taken directly across the drain-

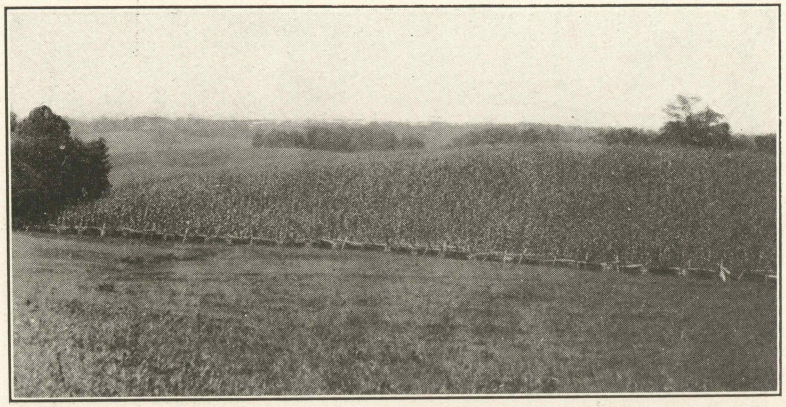


FIG. 29. TYPICAL UPLAND SCENE IN SOUTHERN ADAIR COUNTY.

age lines and gives the usual local effect of a smooth upland, forest-rimmed. The valleys are V-shaped and not readily visible from a distance. The second view is at a low angle across the upper end of a series of ridges and gives a better idea of the characteristic relief of the interior of the Greensburg Area.

The western slopes of the area are drained by the upper Green River and of its chief tributary, the Barren River, in an elaborate dendritic pattern, a ridge reaching into every valley fork. The main streams have broad valleys (Figure 31), the bottoms being in many places a quarter of a mile wide. On the eastern slope, the right-hand tributaries of the Cumberland are short, though numerous, and have cut out more steep-sided valleys. Here the ridges stand out in bolder relief than on the west. Figure 4 shows the dominance of surface drainage in the Greensburg Area as contrasted to the areas west of it.

The surface forms of the area may be subdivided as follows: (1) The remnants of younger cap rocks persist along the ancient northern watershed of the Green. Here belong the Green River Knobs, rising 1,800 feet above seal-level, the most conspicuous landmark west of the Mountains. "From the summit on a clear

day one may see plainly to the eastward the edge of the Cumberland Plateau, and dimly, about sixty-five miles distant along the horizon to the westward, the margin and outliers of the Western Coal Field. The region between is studded here and there with knobs capped with the sandstone on which he is standing."[1]

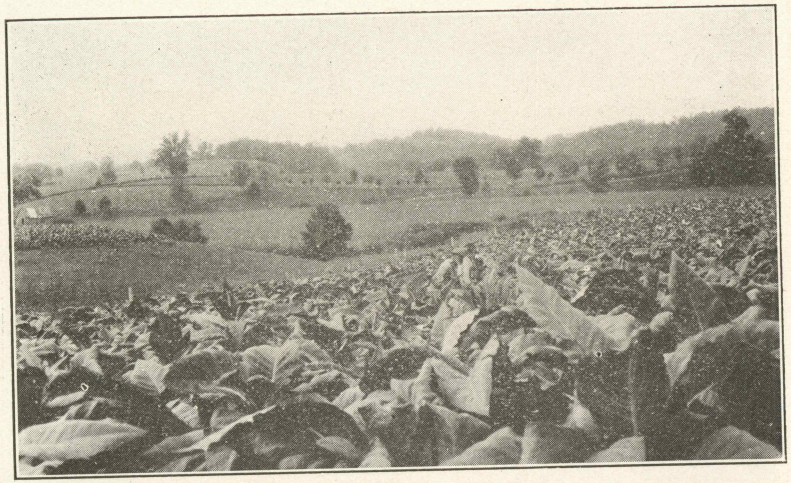


FIG. 30. DIVERSIFIED UPLAND FARM, ADAIR COUNTY.

In other words, remnants of Coal Measures sandstones are scattered all the way from the Western Coal Basin to the eastern "Mountains" of similar formation. The Brush Creek Hills, barrier between the Pennyroyal Plain and the Elizabethtown areas, previously described, are continued eastward through the northern part of the Greensburg Area, by scattered single knobs or groups of knobs, decidedly bolder in relief than the Brush Creek Hills. Largely the conglomerate and sandstone has been removed from them, but on them in places, pebbles from the former cap (jackstones) are so abundant as to make gravelly fields. These dominant elevations of the north are true monadnocks. The lack of a similar feature on the waterparting between the Green and Cumberland rivers is suggestive of the more recent development of this watershed, as discussed in Chapter Three. Sandstone knobs and sand-covered ridges are especially characteristics of northern Green, Taylor, and Casey counties.

[1] Miller, A. M., loc. cit., pp. 200–01.

The surface is fairly rough and the soil most unattractive under these conditions. Mostly the land is forested (Figure 32). (2) Optimum conditions are to be found in central and southern Taylor County and in portions of adjacent counties. The top-

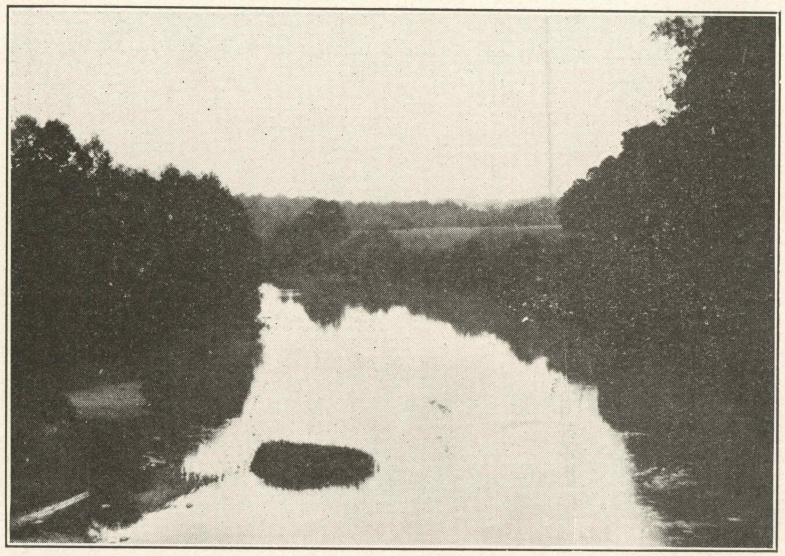


FIG. 31. DOWN THE GREEN RIVER.
This view is at the crossing of Greensburg-Columbia road.

most, oolitic limestone of the Waverly formation,[2] has been worn away almost entirely, but the surface locally has as yet been little trenched by streams. Residual limestone materials from the Spergen and probably from the Mammoth Cave, appear to be still present in this soil and to affect it beneficially. The most important attraction of this heart area is the smoothness of its surface. A moderately heavy, fairly productive soil has formed because the weathered rock products are removed from the surface only very slowly. The land can be cultivated without much danger of washing and agricultural conditions are therefore fairly comfortable. As in the areas of the Mammoth Cave limestones, one might say in almost every upland area of Kentucky, topography is more significant than the composition of the soil.

[2] The Spergen, corresponding to the Bedford stone of Indiana.

Excepting for the gentle slopes of the valley margins the surface of the land is diversified almost solely by slight remnants of solution surfaces. These are short, shallow swales in the upland, in some cases possibly still containing some soluble limestone beds, but largely residual features that have persisted after the rocks in which they were formed dissolved and rotted away. The beds of Mammoth Cave and subjacent limestones may have disappeared, but their differential removal through solution is still recognizable in the persistence of subdued solution features on a surface that is no longer amenable to solution sculpture. These discontinuous, shallow depressions are numerously present but are inconspicuous. Streams are beginning the dissection of the area, the slopes above the head of the stream channel being for the most part very gentle.

(3) A secondary strip of fairly smooth, fairly productive land, still above the average of the area as a whole, is the southwestern margin, especially as found in Allen County, the contact zone with the Mammoth Cave limestone plains to the west. Here again the cavernous limestones have disappeared recently, by solution rather than by stream erosion, and surface drainage has not yet resulted in the establishment of numerous or deep valleys.

(4) The central and largest part of the area, including Adair County and the country adjacent, is still primarily an upland surface, but individual slopes usually involve a relief of one to two hundred feet. For Kentucky it is just a "rolling" county (see figures 29 and 30). Upland tracts, unmodified by surface erosion, are still numerous, but they include ordinarily only a few hundred acres each. Stream bottoms are large enough to be an important part of the farm surface. Valley slopes in many cases are sufficiently gentle so as to permit at least occasional plowing. Slope becomes, however, the most definitely limiting factor in local agriculture; much of the land has passed through several cycles of cropping, each terminating in abandonment on account of erosion.

(5) Especially in the northeastern part of the area, as in Pulaski County, are long ridges underlain by thin remnants of Mammoth Cave limestones, completely surrounded by other

ridges capped by Waverly materials. The persistence of the cavernous limestones in this section is at least partially due to undulating rock structure. A broad belt of such land extends from Jamestown, in Russell County, northeastward to Fishing Creek. These cavernous limestone lands for the most part are

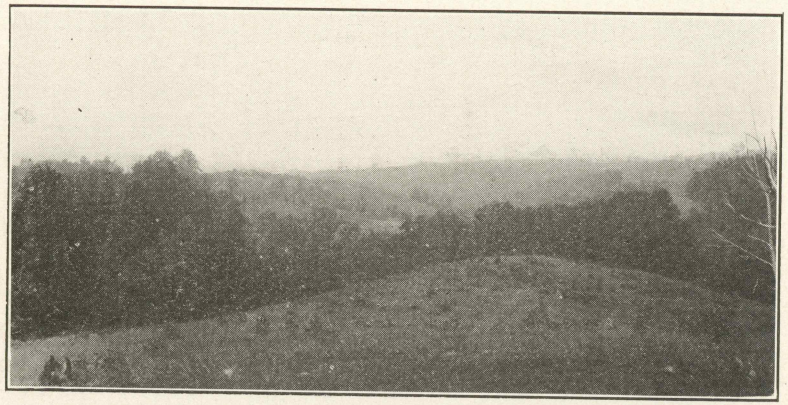


FIG. 32. A SANDSTONE RIDGE.
This view is near Larue-Taylor County line.

neither very good nor very poor. They have a somewhat better forest growth on them than do the Waverly ridges. Solution features are well developed where the thickness of the cavernous beds permits. Economically they are almost undifferentiated from the shaly limestone ridges, or their condition is even less good. The soil color on these ridges is normally red; they are worn down essentially to their sub-soil therefore. These ridges seem to indicate clearly that the cavernous limestone lands are more susceptible to erosion than the shaly limestone areas. Sub-soil at the surface and numerous ravines are distinctly more characteristic of the Mammoth Cave ridges than of those underlain by Waverly materials. The former formation commonly results in a sub-soil that rests directly on fresh limestone at slight depth, the descending water sinking freely through crevices in the rock. In the Waverly horizon, the argillaceous beds have suffered partial decomposition to a more considerable depth. The greater thickness of residual material in the latter either serves as a more effective absorbent of rainfall, as appears most

likely, or it increases the time needed for the effects of slope-wash to have conspicuous results as compared to erosion on the cavernous limestones.

(6) The slopes leading to the Cumberland are deeply trenched by valleys. Here the ridge tops hold elongated communities, strung along a road that leads back to the general Greensburg upland. The rapid cutting of the valleys is suggested by the rather angular contact between valley slope and ridge top, a more abrupt break in slope than is characteristic of the Green Basin.

(7) The basal formations, weak black shales (Devonian) and other soft shales, are exposed in a number of valleys toward the center of the arch. The larger areas are indicated on the geologic sketch map. Here broad, largely non-alluvial valleys result, like those of the Knobs. The upper Green River, with its tributaries, Turkey and Goose Creek, working on this level, has broken across the escarpment of the Knobs and has established a continuous lowland connection with the Bluegrass. This connection was especially significant in the early movement of population from the Bluegrass to the Pennyroyal.

These numerous surface types constitute the major physical variants of the region. The area cannot be generalized into very simple terms. It lacks also strong functional individuality. It is named in this report after its first important settlement, the town of Greensburg, which is marginal to the area in location. The area has had no strong nucleus of attraction. Further reference will be made later to the marginal distribution of towns, which divide the control of the area.

Type Section for Intermediate Conditions in Greensburg Area

A type section of intermediate conditions for the Greensburg Area is represented by Figure 33. This is the vicinity of the cross-roads settlement, known as Blackgnat, situated partly in Green, partly in Taylor County, the main road from Campbellsville to Greensburg crossing the southern part of the section.

On the southern margin, a wide meander of the Green River penetrates the area, its northern slope being a precipitous cliff

more than two hundred feet high. Across the northern edge the East Fork of Pitman Creek flows from east to west. The area consists thus for the most part of an upland between two streams. The slopes to the valley of the Green are shorter and steeper than those towards East Fork, due to the progressive widening

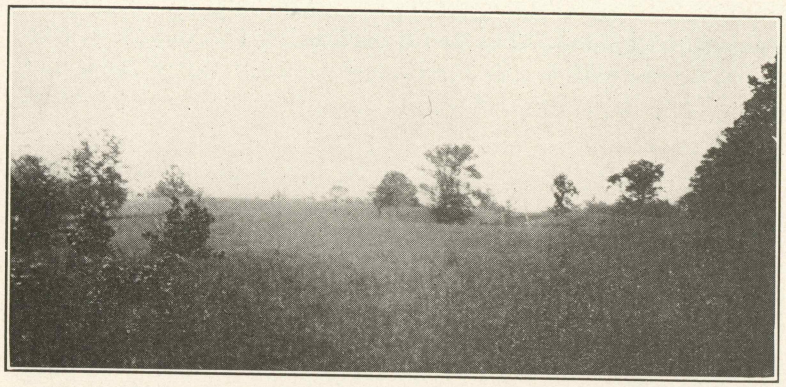


FIG. 34. THE PRIMARY UPLAND.
This upland, formed of Spergen limestone, contains numerous sinks and is located in the Blackgnat section.

of the meander belt of the Green. Not only has the slope to the Green been shortened through invasion by its meander, but the tributaries have had their gradients much steepened and have cut deep, steep-sided valleys.

The central part of the area, between the direct slopes of the two streams, has subterranean drainage. The surface has undergone the normal process of degradation of the limestone regions, whereby locally the original surface, composed of the soluble Mammoth Cave beds, has been destroyed by the enlargement of sinks at the expense of the intervening upland, the result being the reduction of an older surface to a series of short slopes toward numerous sinks. In the area mapped, the Mammoth Cave limestones have disappeared, leaving only fragments of chert as relics. The subterranean drainage, with its associated surface forms, has, however, been preserved by the upper member of the Waverly, the Spergen limestone. This limestone, a coarse oolite, with highly siliceous layers, is susceptible to solution, imperfectly, but sufficiently to develop the features char-

acteristic of a solution landscape. (Figure 34.) It is this rock, and residual features of the Mammoth Cave rocks, which form the upland of the local area. Irregular depressions, areas of convergence of most of the intermittent drainage lines, are small loci of alluviation. The higher areas between, the "primary upland" of the map, are formed from the oolite. The tops of the upland fragments are rather smooth, this horizon having been determined by the base of the easily soluble Mammoth Cave rocks. The slopes toward the depressions tend to be steep, and it is on these slopes that most of the soil erosion shown on the map has taken place. The soil derived from the limestone, though containing chert in abundance, has a clayey texture, and thus yields readily to erosion

Explanation of the features shown on Fig. 33. Type section for the dissected portion of the Greensburg area.

1. Limestone Residuals. These are small detached fragments of upland mapped separately because of their small area and the absence of a smooth top. They are slightly lower in elevation than the upland remnants. The surface consists of a thin cover of soil, through which the underlying limestone frequently appears. All the residuals have suffered severe slope wash.

2. Primary Upland. In the soil occuring on the discontinuous patches of upland there are many fragments of block chert derived from the Mammoth Cave limestones. The smoothness of the tops of these, together with the greater tendency toward subterranean drainage, has largely protected the soil cover from erosion. The underlying rocks are the partly soluble limestones of the Spergen formation. coarse-textured, with much siliceous material derived from crinoid rests.

3. Secondary Upland. Like the primary upland, this surface is the expression of a stratigraphic horizon, the top of the Harrodsburg, a thin-bedded, argillaceous limestone, which yields but slightly to solution. The surface is quite smooth. The parent rock contains many siliceous geodes, which remain in the soil, being particularly numerous where the finer particles have been removed by surface run-off.

4. Transition Slopes. This type was mapped largely on the basis of steepness of slope, and includes that area which is subject to destructive soil erosion where not forested or cultivated with care. Over most of the area, such care has not been used, and the soil in consequence has been washed to a greater or lesser degree. The term "transition" is used because in the process of degradation these slopes are the horizon of erosion, by which the strata of differing resistance are being removed in succession. The result of this process is the formation of lower planes, the "secondary upland" of the map, planes which are approximate stratigraphic boundaries. The type includes as well the gentler slopes toward the stream valleys.

5. First Bottom. The largest continuous area of alluvium within the limits of the map occurs along the East Fork of Pitman Creek, extending upstream along its tributaries. A small segment of the flood

plain of Green River is also included. The type is normal alluvium, marshy in spots, and in places in the valley of East Fork covered with gravel swept down by the stream in time of flood.

6. Terrace. Fragments of terrace cling to the sides of the valley of East Fork. These have undergone extensive leaching, and the limited width permits the erosion of their edges to damage much of their area. The type is greatly inferior to the first bottom as agricultural land.

"Sink" and "basin" are here used in the same sense as in the Lincoln Farm section. The steep-walled basin is a sink whose bottom has become clogged with sediment, similar in origin to the typical basin, but not adapted to cultivation as is the latter, whose sloping sides permit it to be tilled as a part of the field in which it occurs.

Precipitous Slope or Cliff. The highest cliff in the area mapped forms the descent from the upland to the valley of Green River. The steepness of the sides of the valleys of the southward-flowing tributaries causes these slopes to be placed in this category rather than in the more gentle transition class. Cliffs similar in origin to that along Green River occur in places along East Fork, and its tributaries, but are lower. The larger dolines of the upland have precipitous slopes about parts of their peripheries. Rock outcrops occur in all these places.

The stony nature of the soil in the southeastern part of the area is indicated by symbol. Here the Spergen seems to have contained more than the usual amount of siliceous material, which has accumulated in notable quantities in the soil.

Erosion on slopes ranges from the concentration of fragments of cherty material by the removal of fine particles to very severe gullying on the longer and steeper slopes. Though most of the erosion has occurred on the transition slopes, some damage has been done on the upland, where the gradient is slight. This is to be referred to careless methods of handling rather to any peculiarity of soil or surface.

(The boundary line between Green and Taylor counties is only approximate, being drawn as nearly correctly as information given by local inhabitants would allow.)

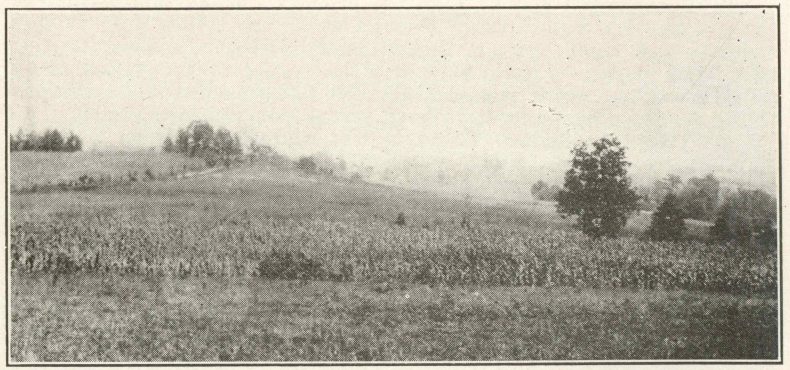


FIG. 35. A RESIDUAL OF THE HIGHER SURFACE.
In the middle distance is the main upland between Green River and Pitman Creek. This view is to the north.

The reduction of the area has proceeded by the removal, largely by solution, of the soluble oolite from a lower and less soluble member (Harrodsburg). This removal takes place by the lateral widening of the solution depression and by marginal

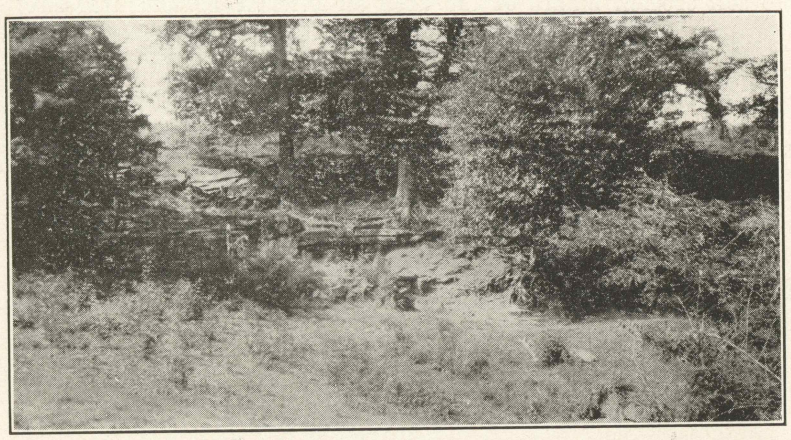


FIG. 36. RIDGE BETWEEN GREEN RIVER AND PITMAN CREEK.
This view shows the south side of the ridge, the narrow valleys head in sinks which have been breached by the headward-cutting tributaries of Green River. Springs occur at these spots.

streams, forming a secondary smoother surface on the lower member. This lower surface is the "secondary upland" of the map. In the process of its formation, isolated residuals of oolite (Figure 35) too small to possess the smooth tops of the primary upland, are left. Their slopes are but thinly covered with soil.

On the secondary upland, erosion is practically entirely by run-off and has not been very effective. The surface lies smoothly except for a few sinks, which with remarkable persistence have held over from a long-vanished surface formed in higher limestones.

With the removal of the soluble limestones the subterranean drainage has been replaced by a pattern of surface drainage lines. This is particularly noticeable on the slopes toward the Green, where vigorous young tributaries are actively invading the upland. The blunt heads of several of these southward flowing tributaries are obviously sinks of the former stage, the southern side of the sink being trenched by the headward extension

of the Green tributaries (Figure 36). Some of these "valley heads" have on their upper sides remnants of caverns excavated in the oolite.

The large percentage of the surface lying in slopes subject to soil erosion makes of the area an inferior agricultural site.

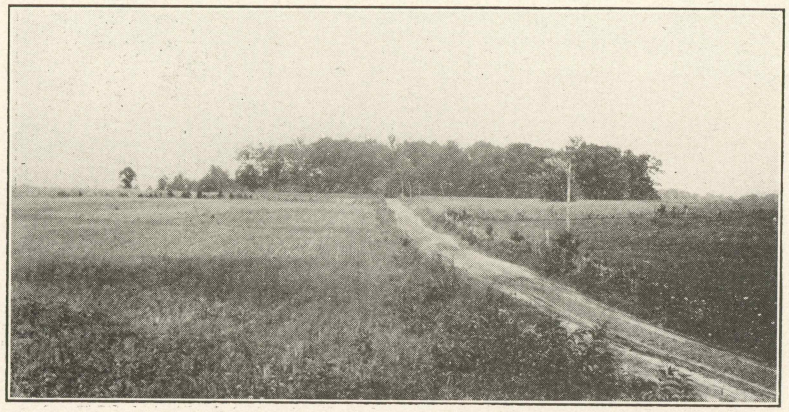


FIG. 37. NEAR SMALL SURFACE STREAMS.
Here dentritic pattern is etched into the plane to which solution reduced the land in the Campbellsville section.

Abandoned land, once formed, but now utterly unproductive, meets the eye everywhere. Some of the most severe slope wash to be found in central Kentucky is encountered here. The destructive effects of ante-bellum tillage are still visible. The superiority of the more gently sloping Pitman side is generally recognized by local farmers.

Type Section for Optimum of Greensburg Area

The second section, which represents the Waverly formation at its best, is located just east of Campbellsville, Taylor County. It comprises parts of the divide between the drainage basins of Pitman Creek to the northwest, and Robinson's Creek to the southeast. Tributaries of both these streams have their headwaters within the area, and one of the larger branches of the former crosses the extreme northwestern corner. The small tributary streams head in springs, which are located in broad, shallow depressions in the smooth upland that constitutes most

of the area. Where these minor spring-fed streams join to form a permanent stream of considerable size, the latter has cut a narrow valley below the shallow depression in which it flows. Their narrow valleys are the most notable breaks in the broadly rounded contours of the landscape (Figure 37).

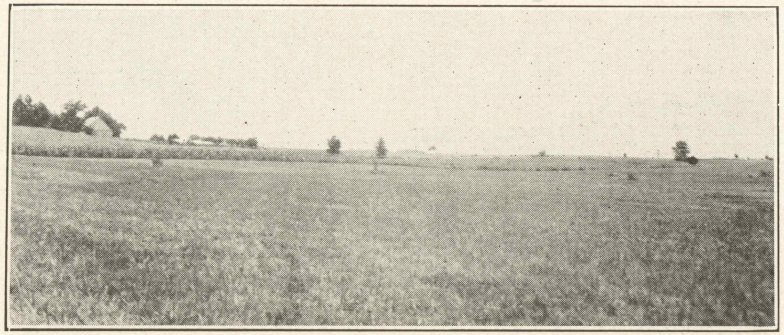


FIG. 38. LOW BROAD SWALES.
These represent the remnants of the old solution depressions developed in the partly-soluble Spergen limestone, in the Campbellsville section.

In the northwestern corner of the area, proximity to one of the "forks" of Pitman Creek has induced active erosion by the intermittent streams of that slope, and the surface has as a result taken on a more thoroughly dissected appearance. Only in this part of the area is there sufficient slope to make soil erosion a menace.

The land rises toward the northeast, and on this higher land the surface soil becomes sandier. This part of the area has had preserved upon it sandy waste from the Pennsylvanian rocks which formerly covered the region. The intervening Mammoth Cave series, as well as practically all of the upper members of the Waverly, the Spergen, has disappeared. The removal of these limestones was accomplished by solution, and hence the insoluble constituents have been inherited by the present surface. Block chert fragments, recognizably derived from the St. Louis, (Mammoth Cave), and crinoid fragments characteristic of the Spergen, are abundant in the soil. The present substratum is the thin-bedded, argillaceous limestone of the Harrodsburg, which, but slightly soluble, normally produces a stream-sculp-

tured landscape. So recent, however, has been the removal of the soluble limestones, that vestiges of the solution topography still remain (Figure 38). The broad, shallow swales, through which the water from the springs finds its way to pronounced valleys, are not the product of these tiny streams. It seems

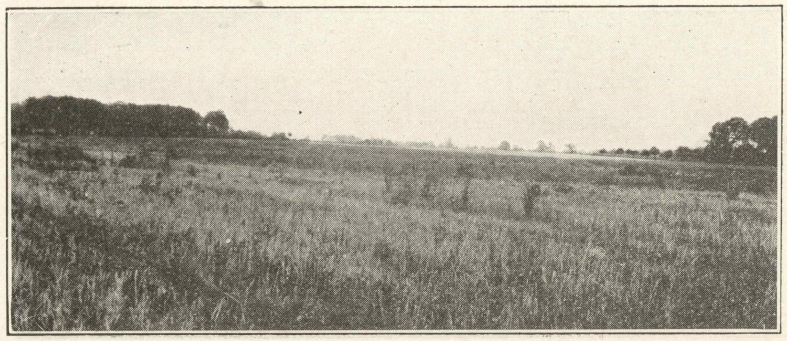


FIG. 39. FLAT SURFACE OF THE UPLAND.
This view shows a near-plane, determined by the horizon of the Harrodsburg limestone, in the Campbellsville section.

more probable that they are the last remnants of the large solution depressions which developed in the purer limestones, floored on less soluble strata below. A few small, shallow sinks are also found. Thus deeply did the impress of the solution landscape become fixed upon the area. The remnants of its features are disappearing under the attack of surface run-off, as the streams push their valleys headward farther into the upland. The smooth surface of this phase of the Waverly (Figure 39) is therefore the expression of the interval between the preceding stage, in which a varied topography was developed by solution, and the latter stream-dissected phase, as developed in the vicinity of the larger streams.

Noncultivable land on the smooth-phase Waverly is at a minimum. The owner of a hundred-forty-acre farm within the area mapped states that the only land on his farm he cannot drive over with a binder is one small sink-hole The particular significance of the smooth character is that the land is not subject to slope-wash. It is largely due to this fact that the region has the appearance of a prosperous farming community, with

improvements far superior to those of neighboring areas. The wasteful one-crop farming methods of ante-bellum days led to a decreased productivity and abandonment of much of the land.

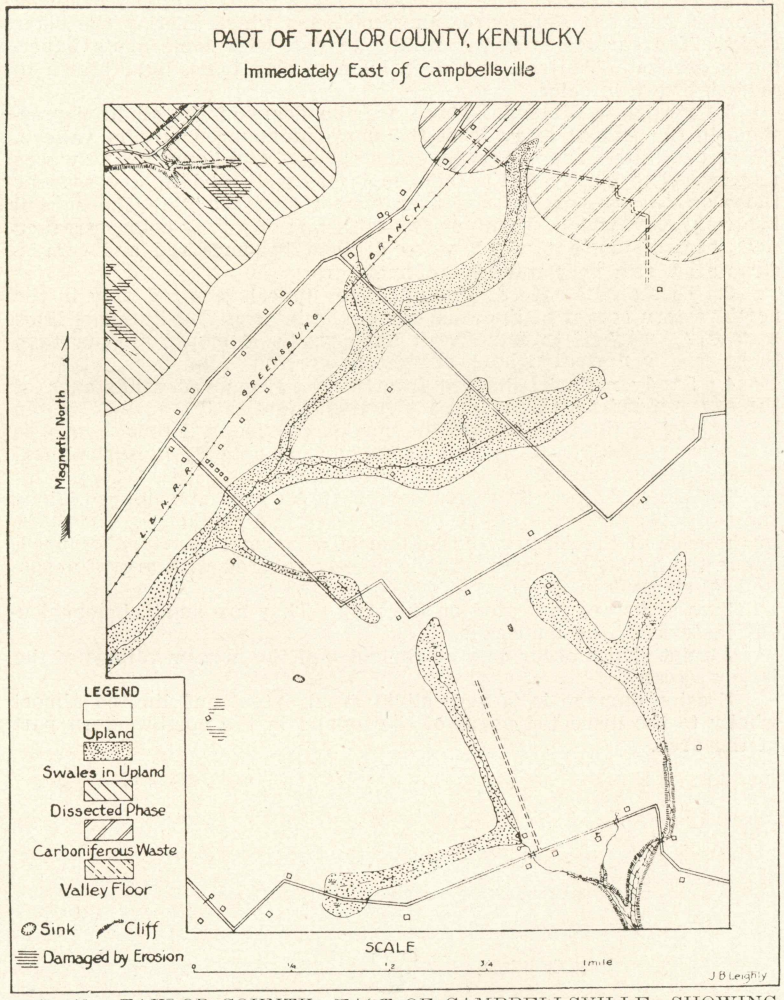


FIG. 40. TAYLOR COUNTY, EAST OF CAMPBELLSVILLE, SHOWING LAND SURFACE.

But even under careless management no washing took place, and when the land was subsequently recleared and more intelligent methods of culture were applied, the land responded with increasing productivity.

Explanation of the features shown on the map. Fig. 40.

1. Upland. This type is the normal for the region, the other forms being variants from it. It is developed on the Harrodsburg limestone, but the soil contains insoluble material residual from the Mammoth Cave and Spergen limestones, as well as sandy and silty particles inherited from the Pennsylvanian sandstones which overlay the older rocks. The surface is gently rolling to flat, with some spots imperfectly drained. The soil is a deep loam to clay loam, light brown to reddish brown in color.

2. Swales in Upland. These are the floors of the slight depressions in the upland away from the more pronounced stream valleys. They constitute a zone of seepage and springs, and hence are in places marshy. The clayey soil retains moisture well, and in dry seasons these swales are particularly favorable for crop growth. The subsoil is a tight clay, which, when poorly drained, is of a gray color, streaked with iron stains, but which when drained becomes red and coarse-structured, still very retentive of moisture.

3. Dissected Phase of Upland. This type is mapped only in the northwestern corner of the area, where the intermittent drainage lines near the "fork" of Pitman Creek have produced slopes steeper than those on the normal upland, subject to erosion.

4. Sandy material derived from the long-removed sandstones of the lower members of the Pennsylvanian, mantles the surface in the higher part of the area toward the northeast. The soil thus formed is of lower productivity than that of the normal upland; in agricultural value it is about equal to the dissected phase.

5. Valley Floor. Two smal lareas of this type are mapped, along the two larger streams of the northwestern and southeastern corners. In the case of the former, the bottom is of normal alluvium, cropped, but in the latter, the narrow flat is largely covered with gravel deposited by streams in flood.

Two sinks are indicated on the map. They are small, inconspicuous features of the landscape.

Abrupt slopes occur only on the sides of the narrow valleys of the larger streams.

Erosion damage is of very slight areal extent and limited almost wholly to the dissected phase of the upland in the northwestern part of the area.

CHAPTER FIVE

NATURAL SUBDIVISIONS: MARGINAL AREAS

The Marion Area

The Ohio River in its course between Shawneetown and Paducah passes through a varied, rugged country, though the local relief commonly is no more than two hundred feet. Small

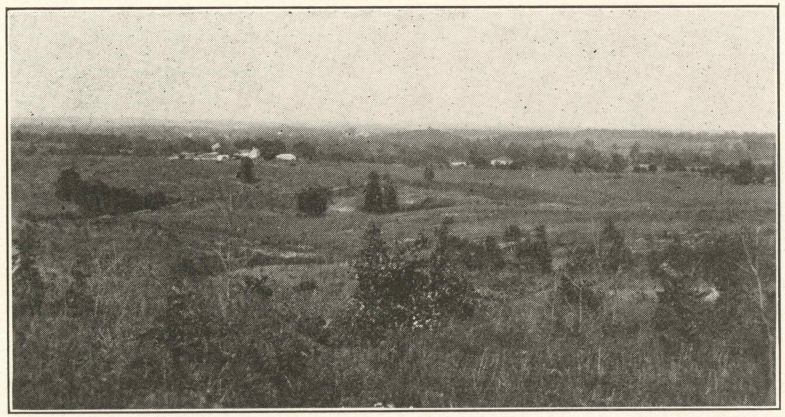


FIG. 41. IRREGULAR UPLAND, PRINCIPALLY OF SANDSTONE.
The view is about five miles north of Marion, looking toward the Ohio River.

bodies of smooth land lie at a series of levels in irregular distribution, forming the summits of ridges and narrow shelves on the slopes. For the most part, ridges and hills, paralleled or cut across by narrow valleys are dominant, but here and there are broad vales, terminated above and below by narrow valleys. The floors of these vales are being dissected by streams.

Though the physical landscape is primarily stream-made, there is little of the regularity either in arrangement or form which usually characterizes a stream-made surface. The stream pattern is neither dendritic nor trellised; the elements of the topography are variable in size, irregular in plan, unsymmetrical in section, diversified in detail of surface, and confused in arrangement. (Figure 41.) This intricate topography is the outgrowth of complex causes: (1) the bed rock is made up of a

series of interbedded sandstones, shales, and limestones of very variable resistance. (2) These beds have been fractured by intersecting faults into a great number of blocks of irregular size, form, and dislocation. (3) Subsequently the region has been subjected to several erosion periods. (4) During the Ice Age the area, in common with adjacent areas, especially those to the west, was mantled by a blanket of loess, and the valleys of the larger streams were partially filled with silt.

The unusual complexity of the topography and especially the disorderly arrangement of its components are closely dependent upon the intricate faulting of the area into a great mosaic of irregular blocks. The disjointed nature and arrangement of the surface forms are well represented on the Golconda, Cave-In-Rock, and Princeton topographic sheets. The longer and more pronounced faults appear to radiate from a center south of Paducah; shorter cross faults intersect the major faults at various angles. These fault blocks have slipped upon one another, producing varying amounts of displacement and tilting of the blocks. Associated with the faulting and bearing evidence as to its origin are narrow dikes of basic igneous rock.

A feature especially worthy of note is that the ridges ordinarily are coincident with down-faulted blocks and the vales are often situated upon up-thrown blocks. Likewise the present scarps are very often the reverse of the original fault-scarps. The topography therefore may perhaps be called one of "secondary horst and graben" features. The streams cut down and broadened their valleys on the non-resistant rocks of the up-thrown blocks, while the preserved resistant rocks of the down-thrown blocks came to stand out as ridges. A conspicuous example is the great eminence of Livingstone County called Newman's Bluff (Golconda quadrangle), formed on a down-dropped block of resistant sandstone and conglomerate. Another scarp of considerable length is Moore's Hill, west of Marion (Cave-In-Rock quadrangle), developed on a sandstone block fronted by a limestone vale.[1]

[1] For a general discussion of the geology of the area see Ulrich, U. S. G. S. P. 26, also the Princeton, Golconda, and Cave-In-Rock Quadrangle studies by Stuart Weller, published by Ky. Geol. Surv.

The selective adjustment of stream erosion to formation has produced a variety of cuesta-like ridges, frequently along fault borders, extending in direct lines or in broad recurving arcs until interrupted by the termination of the fault-block or by a transverse antecedent valley. The frontal slope of the ridges is usually steep and fairly regular; the back slope is broad and

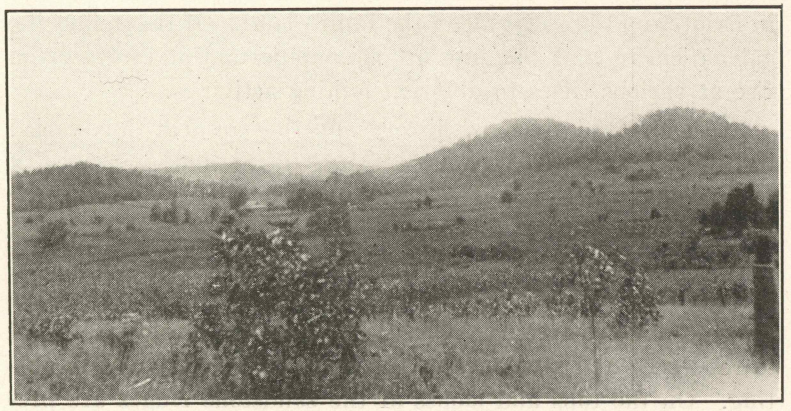


FIG. 42. FREDONIA VALLEY.
This view shows a limestone floored vale in the fault-block country, looking against enclosing ridges of sandstone.

moderate except that it may be dissected by ravines, in many instances following the direction of dip. Invariably the ridges are developed on the sandstones and conglomerates. The broader basins are generally formed on limestones or shales, occasionally on the weaker sandstones. The larger basins are developed on faulted blocks of the Mammoth Cave limestones. Mostly these vales are shut in above and below by sandstone ridges. The fault-block ridges resemble in appearance the outliers of sandstone that occur in other sections of the Pennyroyal. The basins, however, are distinctive. Fredonia Valley (Figure 42) was a well-known feature in the earliest days of settlement. It is a broad solution basin, eight miles long, abundantly dotted with sinks and receiving several good-sized creeks from the sandstone hills. These creeks sink beneath the surface on entering the basin. Similar, smaller, but more strikingly boxed-in depressions are the partly connected Salem and Bethel valleys, of happily chosen names, as well as numerous others.

The shale basins are much more dissected than are the limestone basins, but consist of low rounded knolls, fairly well suited to cultivation. One of the largest of these is the shale basin northeast of Marion, known as Repton Valley.

The faulting that has taken place in this area, and across the Ohio, is responsible for the large concentration of minerals in fissures and breccias along the fault planes. Of these, fluorite, galena, barite, and zinc ores are most important and have given rise at various times to different mining activities.

An involved erosional history affecting an area thus varied in lithology and structure has resulted in the development of a topography which would require the most intensive study for the unravelling of its forms as to genesis. The larger streams have inherited their courses in part from former erosion surfaces, in part they are adjusted to rock formations discovered in the process of down-cutting. The tributaries are largely adjusted to resistance and structure of the rocks on which they are cutting. On the tops and slopes of the sandstone ridges are preserved numerous surface remnants at different elevations that appear to be old erosion levels.

Finally, the area was largely draped by a deposit of floury grayish loess of low fertility. This loess has a depth of from five to twenty feet over much of the area, but it is more than forty feet thick on the uplands along the Ohio. It has added somewhat to the agricultural possibilities of the area, for, to a considerable extent, it mantles the thin sandy soils of the uplands and conceals rock outcrops. Topographically the loess is of little significance. Along the Ohio it has softened the angularity of the bluffs.

The peculiarity of surface forms has given to this fault-block country a distinctive landscape. A view over the sandstone uplands conveys the impression that habitations are situated on separated and detached levels in so far as they are not clustered in the vales. A student approaching the area from the viewpoint of geology would undoubtedly detach it from the Pennyroyal and associate it with the cognate country in southern Illinois. Geographically, however, we made note that (1) the site on which most of the population lives, the vale, is physically

identical with the other marginal areas of the cavernous limestone; (2) that the sandstone ridges have site values similar to the Clifty margin of the Pennyroyal; and (3) that the area was entered from the Ohio and Cumberland rivers and from the Pennyroyal Plain by the same kind of people as the rest of the Pennyroyal, and that culturally it is and always has been Kentuckian.

Type Section for Marion Area

The type section is located on Crooked Creek, a mile and a half northeast of Marion, county seat of Crittenden county. This type does not include a distinctive vale, but does represent the character of the sandstone blocks, and includes some minor outcrops of limestones and shales.

The stream pattern is highly irregular. The major part of the course of Crooked Creek appears to be antecedent. The smaller streams are subsequent. The section is submitted not in explanation of geologic structure or of erosion history but to illustrate the forms of articulation of the upland surface and the complex courses of the drainage and their interrupted bottoms. Over this helter-skelter surface, excepting the steep slopes, a concealing mantle of loess or loess-like silt is thrown, producing on the uplands a surprisingly uniform soil, the utility of which is determined almost solely by slope conditions. In the local creek bottoms sandy soil predominates.

Figure 43: Explanatory legend for Type section of Marion Area.

(1) Summit levels. Flat topped or moderately rolling tops of the highest local hills, approximately 700 feet above tide.

(2) High-level benches, in sandstone predominantly, situated at two principal levels, approximately fifty and one hundred feet below the summit level. These appear not to be correlated with particular rock horizons and may therefore represent two erosion levels now largely destroyed.

(3) Low-level benches and small basins, developed principally on limestones and shales. They are in process of dissection by tributary drainage. The lower basins, such as the one on the left hand tributary of Congo Creek are only thirty to fifty feet above the level of true flood plains adjacent. The gradient of this stream is steepened between its upper basin and its place of entry into the Congo bottom, and it has begun the entrenchment of its course in the upper basin.

(4) The larger streams have flood plains with fairly high gradient of streams. The gradient of Crooked Creek is about ten feet to the mile. Even these broader bottoms may be considered as temporary

levels developed on weak formations, while cutting on more resistant formations downstream is proceeding slowly. The width of the bottoms is very variable. Particularly notable is the broad bottom of Crooked Creek at the west of the section, which gives way a short distance downstream to a narrow valley almost without bottoms.

(5) The steep slopes are the abrupt fronts of scarps, as on Crooked Creek in the central part of the section, and the areas of greatest dissection by ravines.

(6) Moderate slopes are formed on the back slopes of the blocks and on rocks of lower resistance joining the bench levels.

The Northern Clifty Area

Breckinridge County and adjacent parts of Meade, Hart, Grayson, and northern Edmonson counties form the northwestern margin of the Pennyroyal. The Mammoth Cave limestones dip westward beneath the Chester beds, largely sandstone, which form most of the surface of this area. The contact between limestone and sandstone is marked (1) by a conspicuous escarpment of sandstone, in places two hundred feet high, (2) by outliers of the sandstone, forming knolls in the limestone plain, and (3) by deep solution depressions or dolines in the sandstone area, but floored by limestone. The escarpment is very ragged in outline and before it are clusters of outlying sandstone bodies decreasing in size and number away from the escarpment. The dolines are of irregular distribution, being most numerous in the vicinity of the larger streams, as the Rough, Nolin, and Green rivers, but in some localities are produced by local arching of beds, as in the large Calamezer-Lost Run doline in Breckinridge County. The boundary against the Elizabethtown area is placed sufficiently far to the east of the escarpment so as to include in the Clifty area those districts in which the outliers from the predominant element in the surface.

The area therefore is dominated topographically by sandstone beds, more resistant to erosion than the limestone surfaces to the east. The drainage is in general, though not exclusively, west from the escarpment. The land immediately west of the escarpment contains the most youthful and least numerous streams of the area, and is in consequence a rather smooth tableland (see Figure 48). The relief increases westward, as well as toward the Ohio and Green valleys. Except where the streams have broken through the sandstone beds and have established

their floors on the limestone beneath, the topography is not rough, but rolling. Where the basal, weaker rocks are exposed, the resistant cap gives rise to cliffs and the bottoms increase notably in width. This landscape is described locally as "clifty" and includes scenically the most interesting parts of the area. Big Clifty Creek is an illustration in point. It furnished the original name of the sandstone, now superseded in official geologic usage by a foreign term (Cypress) in the interests of stratigraphic correlation. The older name is still most desirable geographically because it is expressive of the most striking quality of the local landscape. Minor benches appear to be the result of local outcrop of weak shales and limestones interbedded with the sandstones.

Doline features are less numerous than in the Southern Clifty Area. Sinking Creek in Breckinridge County is one of the most conspicuous. It discharges into the Ohio at Stephensport and has its source on the Elizabethtown plain. Through the entire width of the sandstone belt, the sandstone rocks have broken down or have been cut through along this valley. The drainage system of Sinking Creek forms several elongated limestone basins that reach back to Elizabethtown upland, having between them detached, clifty blocks of sandstone.[2] The Calamezer doline includes a central limestone basin two miles in diameter with several prongs, through two of which water drains out of the basin. This doline is completely surrounded by sandstone uplands. Its formation was aided by local arching, the center of the limestone basin being on the axis of an anticline.

The "pilot knobs," hogbacks, and other detached sandstone blocks east of the escarpment are for the most part doline remnants, not the result of the more ordinary detachment by surface run-off and weathering. Sinking Creek for instance, having a typical doline for its lower valley, heads in a limestone country south of Irvington which is abundantly dotted with sandstone outliers. These are so arranged with reference to the drainage of the limestone surface that they are evidently reduced remnants of doline walls.

[2] See the Hoeing map of Meade and Breckenridge Cos. (1891), Ky. Geol. Sur.

The surface of the sandstone upland ordinarily is not sandy or only slightly so. For the most part the soil is a silt. Good sub-soil oxidation gives a red color to most of the sub-soils, the surface soils being in general buff. The soil is derived in part from the bodies of shale and limestone that were interbedded with the sandstone or covered it at one time. It is also certainly derived in part from loess, brought in principally from the Ohio Valley. The texture of the surface material on these sandstone uplands is only one of a series of indications found widely through the state of Kentucky, suggesting that an ancient loess-sheet, rather than the weathering of underlying rock formations may have been the principal source of the present agricultural surface. The sandstone has controlled the topography in part in the local area, but it is not strongly expressed in the local soils. These in fact are strangely reminiscent of the uplands of much of the Greensburg Area. The land is distinctly lower in fertility than on the cavernous limestone plains, but where properly fertilized it yields fair crops and is especially valuable for tobacco farming.

The country about Hardinsburg, being little dissected, is representative of the upland at its best. It was considered sufficiently desirable during the first settlement of the state to receive one of the earliest colonies planted west of the Bluegrass. In most of the area soil erosion is not conspicuous, possibly because of the porosity of the underlying sandstone and partly because the fertility of the land was not such as to tempt the clearing of many steep slopes.

The area gravitates toward the Elizabethtown country, with its major lines of communication. Its agriculture is of the same type as in the limestone country. Its most conspicuous surface features are solution-made and are bedded on the cavernous limestones. It is much more distinctly marginal to the Pennyroyal as a geographic site than to the Coal Basin and it is placed therefore into the former regional association.

The Southern Clifty Area

A narrow fringe of continuous sandstone ridges and table lands stretches westward from the Green River below Munfordville to Caldwell County, where it disintegrates into the fault-block country of the Marion Area. To the south is the smooth Pennyroyal Plain. At the northeast it is separated by the valley of the Green and the Brush Creek Hills from the Northern Clifty and Elizabethtown areas. To the north are broad, swampy valleys and low uplands in the Western Coal Basin. The southern part of the sandstone highland is of Mississippian age; the northern part is Pennsylvanian. Until the area is further known it appears desirable to accept the line between the Mississippian and Pennsylvanian as the divsion between the Pennyroyal and Coal Basin. Although the boundary is thus placed near the middle of an upland country that lies between two lower belts of land, the choice of the formational boundary is supported by the following considerations:

(1) The southern part of this barrier belt, the Southern Clifty Area of this report, is immediately adjacent to the Pennyroyal Plain and entirely dependent thereupon for its commercial and political connections. It is far from fortuitous that Warren, Logan, Todd, Christian, and Caldwell counties, of the Pennyroyal Plain, should include also the whole of the Southern Clifty country. The latter has no market or court towns of its own. To the south are the prosperous country towns of the limestone plain and the highways to the outside world. To the north lies a rougher country than that of the clifty sandstones and an even sparser population. The sandstone margin of the area faces south therefore, and is a "highland rim."

(2) The Pennsylvanian rocks of the barrier belt contain coal and associated mineral resources and are therefore being gradually opened up by lines of transportation from the more central, topographically lower parts of the Coal Basin.

(3) The drainage of both sandstone belts is mostly into the central part of the Coal Basin. The watershed between the Green and Cumberland drainage is south of the sandstone country, in the solution plain of the Pennyroyal. From the Pennyroyal Plain the water flows across the Mississippian sandstone and then across the Pennsylvanian sandstone and conglomerate into the shales of the Coal Basin. Valleys are, therefore, more numerous and more advanced in the Pennsylvanian area than

in the Clifty country. They grow bigger and deeper northward primarily because they are older, possibly also because the Pennsylvanian rocks may favor a more rugged dissection.

(4) In the Clifty Area the Mammoth Cave limestones are basal, and the doline is the most striking surface feature of the

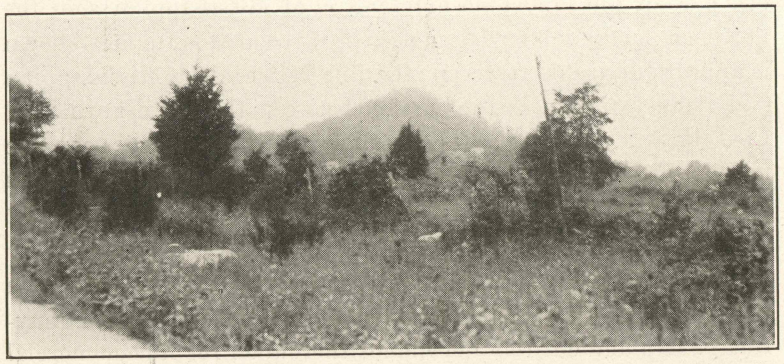


FIG. 44. KNOB AT EDGE OF CLIFTY AREA NEAR RUSSELLVILLE.

area. Northward this strange and impressive feature of the landscape disappears.

The Southern Clifty Area resembles the northern area of the same rock formation, except that the doline is a more striking part of the landscape and that it is tributary to a different part of the Central Pennyroyal. The term "clifty" is generally employed locally; this section has another Clifty Creek and a settlement by that name. A not inconsiderable part of the Pennyroyal Plain drains northward underground, beneath the sandstone. In numerous places the sandstone has broken in over such a subterranean passage, which may hold a subterranean river of small size. The stream may appear at the surface at the head of the doline and disappear under the sandstone again at its lower end, or it may remain beneath the floor of the basin, especially if that floor is composed of detrital material from the sandstone cap. The oldest stage of doline development has resulted in ragged outliers of sandstone on a continuous lower surface of limestone, as in the Northern Clifty Area.

The escarpment consists typically of a steep upper slope and of a foot-hill belt of limestone ledges, in steps. The surface of

the Pennyroyal Plain is not formed upon the higher limestones. These have disappeared over the smooth plain, but outcrop as knobs, tongues, piedmont slopes, a complex glacis, along the sandstone escarpment. They are known locally as "glades,"

FIG 45. GLADE COUNTRY ON MARGIN OF CLIFTY BELT.
This shows region between Russellville and Hopkinsville.

thin limestone uplands with numerous outcrops of very white rock ledges and bowlders. On such dry slopes, red cedar and coarse grass are the dominant vegetation. (Figures 44 and 45.)

Type Section of Clifty Area

The type section was chosen at Glasgow Junction and represents a strip from the Pennyroyal Plain onto the Clifty upland. The Louisville and Nashville Railroad and the Dixie Highway here skirt the base of the sandstone escarpment. Figure 46 shows a view toward the escarpment.

If one follows one of the minor roads which lead from the solution lowland northward into the highland, he encounters a country that is markedly inferior to the smooth limestone landscape left behind. Even the basins which separate the tongues and outliers of highland have a somewhat poverty-stricken appearance. The solution depressions here are larger than on the

Pennyroyal Plain and are separated by distinct knolls. On the latter the soil is thin, and much bleached limestone shows, its surfaces rounded and grooved by karst weathering (Figure 47). Most of this piedmont surface was once under cultivation, but the thin soil on the sloping ground could not long endure

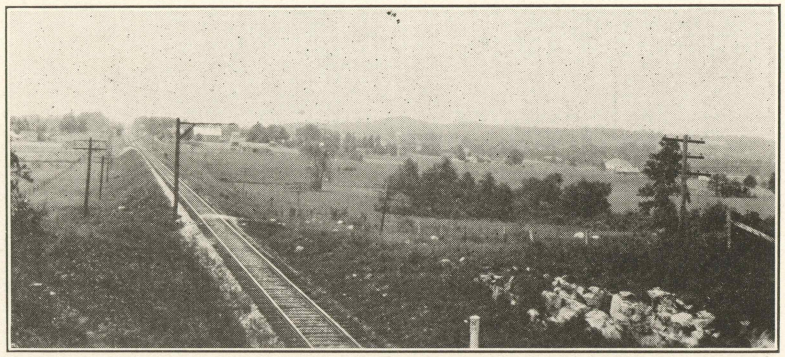


FIG. 46. LOOKING TOWARD GLASGOW JUNCTION.
This view is from a low outlying knoll in the Glasgow Junction section. The main escarpment of the Chester sandstone is in the distance.

slope wash. At present little land except in the sink bottoms is cultivated.

From these lower areas, locally known as "valley land," the ascent to the "upland" is by steep slopes, uniformly forested. Where rock is visible on these slopes, it is a moderately coarse sandstone of reddish brown surface color. The upland attained (Figure 48), its surface is seen to be quite smooth, but by no means continuous. In addition to the "valleys" which penetrate deeply from the lowland to the south, it is interrupted by many "hollows," at the edges of which the surface drops abruptly by a hundred to two hundred feet of steep wooded slope to irregular bottoms. These hollows are extremely irregular in plan, ramifying in every direction, and thus cutting the upland into patches, connected by narrow, flat ridges.

It is below these fragments of upland that the labyrinth passages of Mammoth Cave and of other less well known but no less impressive caves have been carved out by underground waters. The Cypress sandstone which caps the upland, and its

is short-lived under cultivation. The uplands were put under cultivation later than the "valleys," but in spite of their freedom from slope wash, much of the land has already been abandoned on account of the exhaustion of its limited fertility.

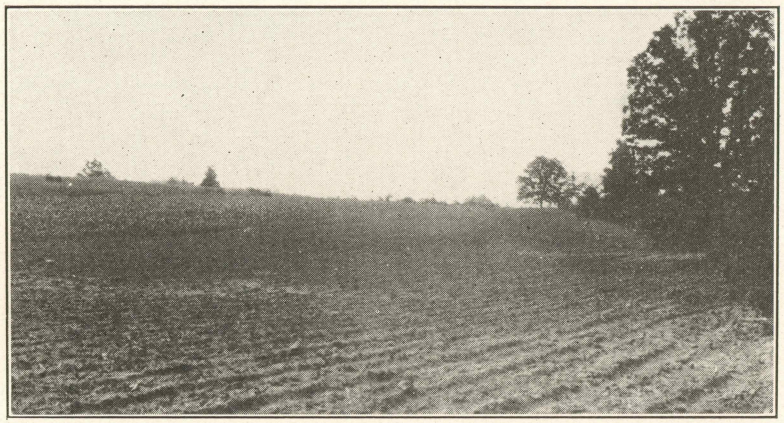


FIG. 48. SMOOTH UPLAND OF CLIFTY AREA.
This view in the Glasgow Junction section is immediately behind the escarpment.

The soil of the glady valleys was originally fairly productive, but stood up poorly under cultivation. A decided advantage in fertility was possessed by these areas because of the mixture of limestone and sandstone debris. But the relief of the underlying rock surface, greater than in the Pennyroyal Plain, and the slight depth of soil encouraged the sweeping of the soil material into the depressions when cultivation began. With this migration of the soil to the lower parts of the area, cultivation has of necessity kept pace. Crumbling ruins of houses and those precursors of the returning forest, persimmon and sassafras, bear witness to man's defeat in the unequal struggle against soil erosion.

This is the principal cave country of Kentucky because of the association of a soluble substratum and a resistant cap. A special literature has developed on the Kentucky caves, centering principally upon Mammoth Cave. The reader is referred to two exhaustive bibliographies for further reference to these features.[3]

[3] Jillson, W. R., Bibliography of Mammoth Cave, Ky. Geol. Surv., Ser 6, vol. 10. Hovey, H. C., in Bull. Geol. S. Am. (1912), vol. 23, p. 747.

waste, are easily permeable to the water falling on the surface. The pure limestones beneath yield readily to solution and become honeycombed. When the limestone is removed to such a degree that the overlying rock can no longer be supported, the caverns

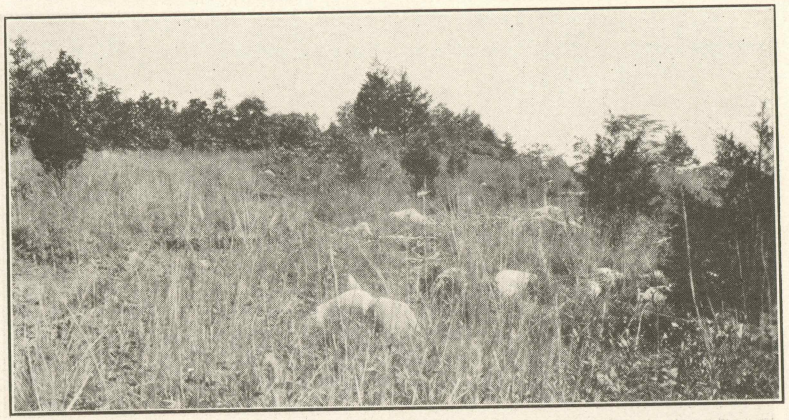


FIG. 47. GLADE LAND.
This view in the Glasgow Junction section shows limestone boulders and scattered red cedars.

collapse. Both the "hollows" and "valleys" beyond the escarpment are dolines, of identical origin but differing in stage. On the slopes of both may be seen many blocks of sandstone.

Even more prominent than the detached blocks of sandstone is the great mass of sandy waste derived from the disintegration of the sandstone. This mantles the slopes far below the horizon of outcrop of the bed rock, and disappears only slowly from the soil to the lower surfaces, whose substratum is the Mammoth Cave limestone. That this sandy waste is removed in suspension by underground drainage, as the material of the limestones is removed in solution by the same waters, is attested by the presence of the floors of the caverns of siliceous deposits. On the slopes of the "valleys" and in their glady bottoms the soil is sandy, and this sand content lessens gradually as the true limestone land of the Pennyroyal Plain is reached.

The soils of the upland are much sandier than in the Northern Clifty Area. Though their surface is smooth, so that they are not subject to erosion in any large measure, their usefulness

The type section is illustrated in Figure 49.

Explanation of the features shown on the map:

1. "Upland." This local term is used to designate the smooth summits of the fragmented highland capped by sandstone. The surface is flat to gently rolling, and hence but slightly affected by soil erosion. The soil is a fine sandy loam, reddish to yellowish in color, paling to white where exposed to the weather. It is deficient in organic matter, and evidently deteriorates rapidly under cultivation. At the edges of the "hollows" within the upland, and of the "valleys" opening out upon the mature solution plain toward the south, the surface drops sharply away, the slopes forming.

2. Stony Sandstone Slopes. In this category are mapped not only the descent from the upland to the bottoms of the "hollows" and "valleys," but also the narrower ridges and isolated hills formed by the sandstone. These slopes are uniformly steep, and have had scarcely any of their area cleared of the forest growth. There is, nevertheless, a nearly continuous soil cover, derived from the weathering of the sandstone of which the slopes are formed. The rock visible on the slopes consists in many places of detached blocks of sandstone, slumped from their original position. The type is mapped lower on the slopes than the outcrop of the parent sandstone, since the mass of sandy waste has masked the limestone to a level near the bottoms of the hollows and valleys. In the hollows, in fact, the limestone does not appear; the surface, formed of sandstone blocks mantled with sandy waste, slopes abruptly to the funnel-shaped sinks which give outlet to the surface drainage.

3. Glade. This term is used to designate the zone of limestone outcrop at the foot of the sandstone slopes, and on the floors of the valleys. Soil cover, where present, is thin, and lies in depressions in the limestone surface. The limestone appears frequently, bleached by exposure to the weather, and characteristically pitted and furrowed by ground water. On the valley floors, this type occurs on the higher parts of the irregular surface of the limestone, between the sinks. The area of the type is increasing, as the soil cover is swept from the surface of the limestone to the bottoms of the depressions. This type is characterized by the growth of red cedar (*Juniperus Virginiana*), and the young reproduction of this species is a measure of the progress of the denudation of the limestone surface.

4. Limestone Surface with Shallow Soil. This type is distinguished from the normal type of the Mammoth Cave surface of the Russellville area to the south by shallower soil, and by a greater relief of the underlying rock surface. These features promote more rapid and most destructive soil erosion, which has brought the surface to a state of less productivity than that possessed by the normal type.

5. Mature Solution Surface. Beyond the foot-slopes of the highland and outside the "valleys" penetrating the upland, the soil cover on the Mammoth Cave limestone becomes thicker, and the relief of the rock itself less. The surface is thickly dotted with sinks. Erosion takes place on these slopes, but not to a degree sufficient to expose the rock. The soil is a red loam, containing frements of block chert derived from the weathering of the limestone. The soil contains much sand derived from the sandstone, but less than that of the preceding type. This is the best farming land, by far, in the area.

6. Basin Floor. No distinction is made here between the alluvial-colluvial accumulation in sinks in different parts of the area. These areas, however, are of much greater significance in the "valleys" than in the mature solution plain beyond the highland. In the valleys they tend to be larger, and the soil contains a higher percentage of sand. Hence it is better-drained, and since so much of the surface of the valley floor is destructively eroded, the basin floors constitute practically the sole permanently cultivable land. In the mature solution type, the basin floors are small, and the soil contains a greater percentage of finer material, derived from the limestones. The resultant imperfect drainage causes many to be too wet to permit the best growth of crops.

The "ponds" mapped are sinks the bottoms of which have become clogged, and in which water collects. "Sinks" are the solution depressions which still permit free drainage of water to underground channels.

Soil erosion is practically limited to the land included in the solution types. By far the greatest harm has been done on the thin-soiled type, where the removal of soil has left but a thin cover of waste, if any, on the solid rock. As mentioned above, this process is reducing the land to the glady state here recognized as a separate type. On the mature surface toward the south of the area, erosion has for the most part been of the sheet type, particularly marked by a surficial concentration of the fragments of block chert weathered out of the Mammoth Cave limestones. The most destructive erosion has taken place in the extreme southern part of the area, where the topography is rougher than elsewhere. Here gullying has taken place on the longer and steeper slopes. The area of sandstone upland mapped as eroded lies in steeper slopes than is normal. Sheet erosion has reduced its usefulness so that it is abandoned, and a growth of native vegetation is giving it the necessary protection it lacked under cultivation.

The Interfluvial Area

"Between the Rivers" is a common Kentucky designation for the country between the lower Cumberland and Tennessee rivers. This narrow body of land between large rivers, not greatly used as highways, is largely isolated, being crossed only by one important line of communication, at Grand Rivers, where the two streams lie within four miles of each other.

The lower Tennessee follows closely the margin of the Coast Plain sediments against the bedrock formations to the east. The valley of the Cumberland is cut in the limestone surface. The zone on either side of the rivers has been generally dissected for a distance from four to six miles. Between them many of the tributary valleys interlock, leaving the upland as a very irregular, more or less disconnected ridge, with a few smooth summit areas. The river bottoms, together with the many level-floored tributary valleys contain most of the land that is suited to cul-

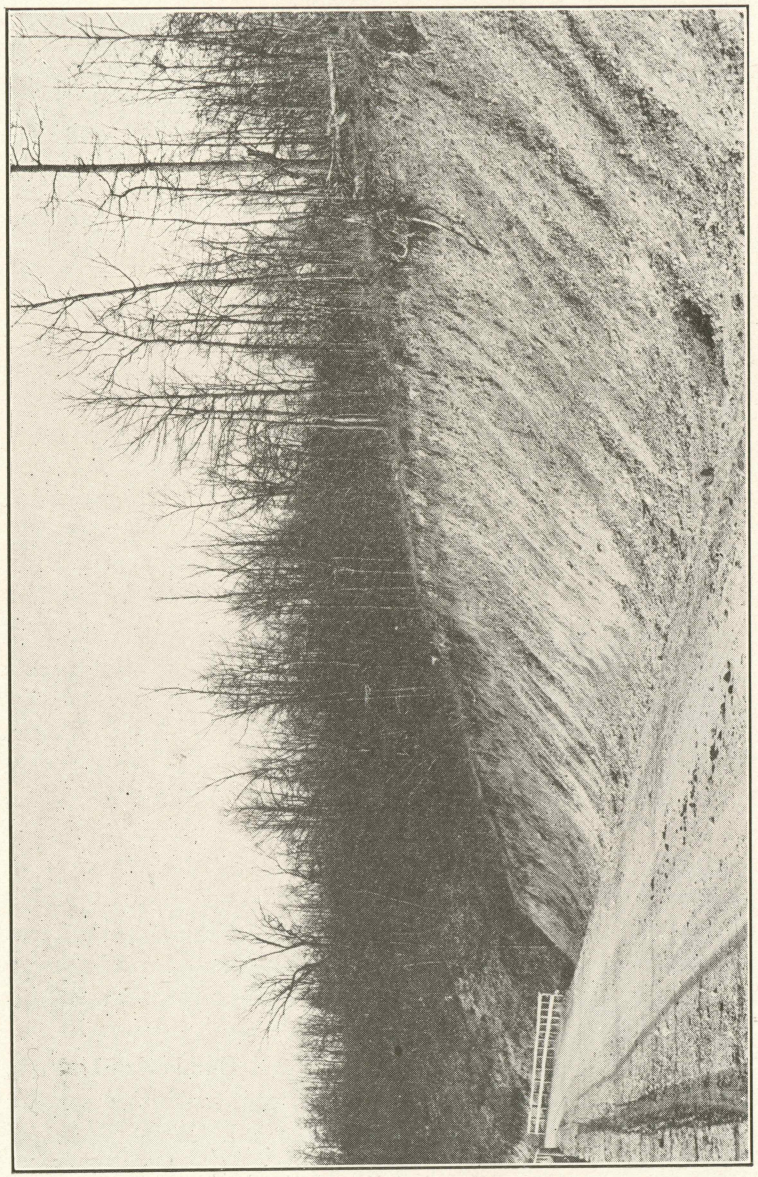


FIG. 51. JEFFERSON DAVIS HIGHWAY NEAR THE HEAD OF GARDENER HOLLOW.
This view shows cut in the gravel beds that compose the major part of the upland in the interfluvial area.

tivation. The narrow, wooded ridges, constituting the larger part of the area, are almost uninhabited.

A region dominated in landscape by forest, sparsely populated and little visited by outsiders, separated and isolated in its neighborhood life, divided in its outlook, little touched by progress, the Interfluvial Area forms a marked contrast to the Pennyroyal Plain, of whose western margin it is an extreme stream-shaped variant. In the simplicity and recency of its surface forms the area has no parallel elsewhere in the Pennyroyal.

Almost the entire region is underlain by very cherty, nearly horizontally bedded limestones of the Mammoth Cave series; in the north, a small area about Smithland has block-faulted sandstones, shales, and limestones. Across the line, in Tennessee, the cherty limestones form conspicuous, rocky eminences several hundred feet high, such as Cedar Bluff and Pine Bluff, above the valley of the Tennessee. In Kentucky, however, the bedrock has had only a slight influence on the present topography. Rock outcrops are far less numerous than might be expected in such a dissected upland; they occur for the most part only in scattered locations near the base of the slopes, and increase in frequency eastward.

The scarcity of rock outcrops is due in large part to the fact that the underlying formations are deeply mantled by various gravel deposits (Figure 51), usually in a clayey matrix. The limonite ores worked in this area in earlier years occur in connection with these gravels. Locally the gravel is cemented into a conglomerate by iron, but for the most part it is unconsolidated. These gravels not only constitute most of the upland, but their loose and sliding character has caused them to slump over most of the valley slopes and to conceal the rock-cut sides of the valleys. They were doubtless built on the seaward margin of an old land surface, over which the sea encroached occasionally.

During the Ice Age the Tennessee and Cumberland rivers, flowing northward from an unglaciated country into a greatly flooded main, had their lower courses ponded. Even the larger tributary valleys were ponded in large part. A flood plain, higher than the present was thus built, consisting of a light-colored loam with pebbles distributed irregularly through it.

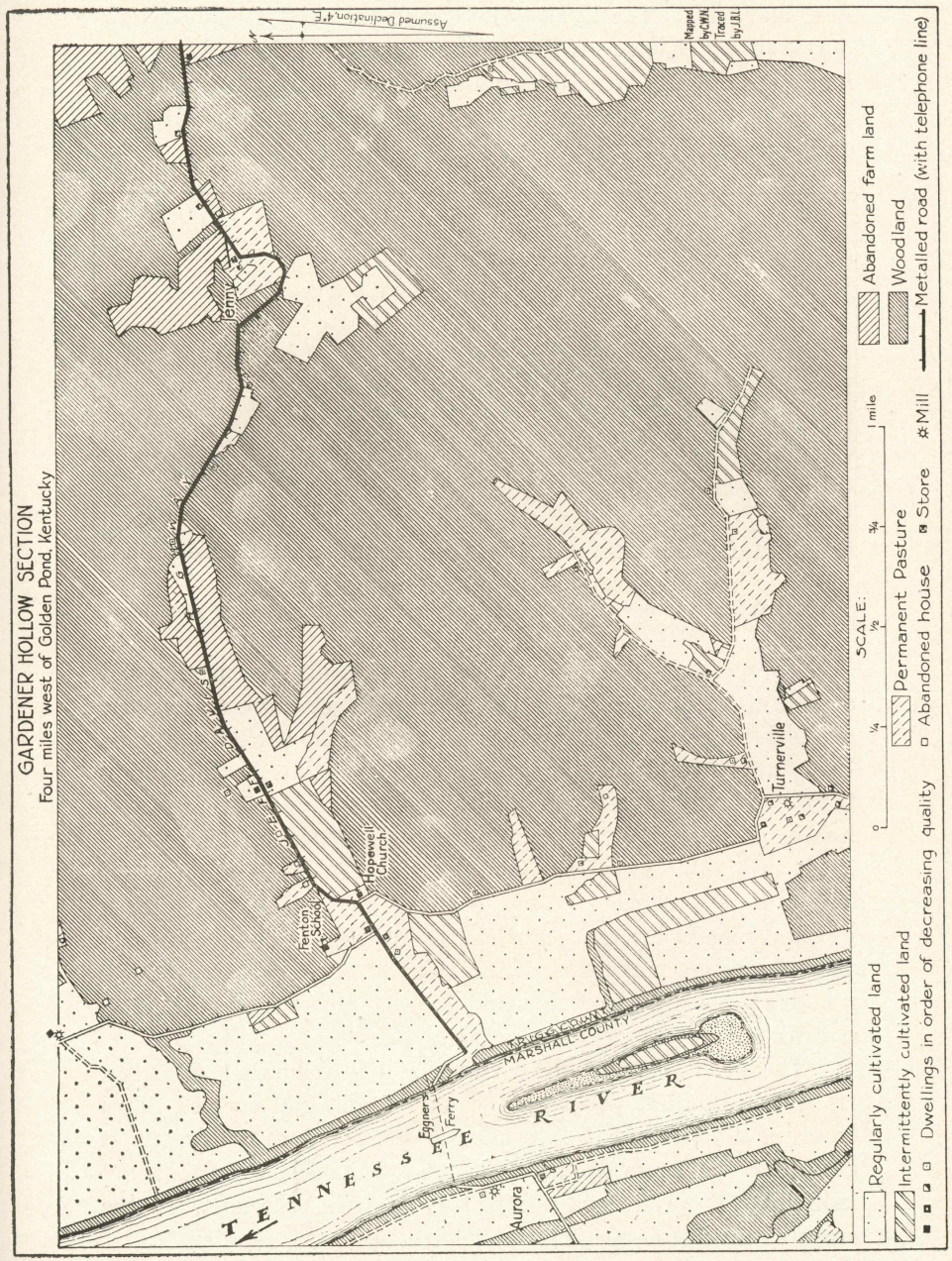


FIG. 52. MAP OF GARDENER HOLLOW SECTION, SHOWING UTILIZATION OF THE LAND.

The floors of the ponded hollows were built up principally of finer materials. The light-colored, even-textured, stoneless, powdery soil which veneers the gravel deposits of the upland remnants is evidently wind-deposited and may belong to the glacial period. It is so deficient in lime that bluegrass does not grow on it readily.

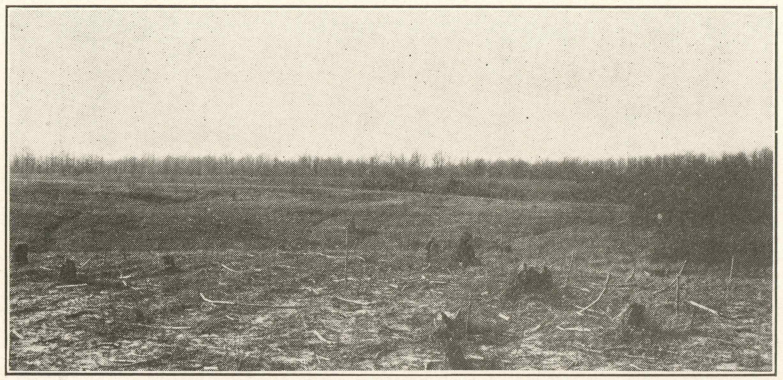


FIG. 53. CLEARED PORTION OF JENNY RIDGE.
In the Gardener Hollow section, the surface is thinly covered with loess-like silt and in process of erosion.

The present flood plain of the two rivers is characterized by a natural levee, from which the surface slopes down to a poorly drained "sag" along the river-ward edge of the older flood plain. Upstream the difference in level of the present flood plain and of the older terrace lands disappears, the latter near the Tennessee line being covered by modern flood plain deposits. The "sag" lands originally were swampy and covered by standing water long after the recession of the floods. They puddle badly when wet and remain lumpy or gravelly on drying. Their soil is considered stronger than that of the older flood plain, but produces a better yield only in wet years, for, though flooded each year, it dries out greatly in dry weather.

The flood plain of the Cumberland is somewhat different. Its soil is sandier, probably because of material carried down from the mountains; it does not puddle, nor does it dry out as greatly as the Tennessee bottoms. The Cumberland bottoms are still likely to produce a satisfactory crop in seasons when the crops of the Tennessee bottoms "burn up."

Practically the only effective effort toward the improvement or permanent extension of cultivated land in recent years has been the drainage of part of the wet land, accompanied in general by gradually diminishing yield.

The site value of the area is determined particularly by the fact, that unlike the Pennyroyal Plain adjacent to it and parts of the fault-block country, this section was and still is well forested. The explanation was offered fifty years ago that the breaks of the rivers served as a vegetation barrier.[4] The primary cause of local prairie conditions in Kentucky is thought to have been fire (see Chapter VII). Fires were unable to cross the river barriers or to sweep the hilly land effectively, according to this notion, which is probably correct. The striking lack of prairie areas, in the Interfluvial Area, immediately adjacent to and between great stretches of grass-land is in fact a strong confirmation of the fire origin of Kentucky prairies.

Type Section of the Interfluvial Area

Figure 52 shows the type section of the Interfluvial Area. In the northeast is part of "Jenny Ridge," a very irregular upland remnant wedged between the dissected slopes of the two rivers (Figure 53). A slightly uneven surface is now being furrowed by small gullies induced by cultivation. The surface is mantled to a depth of three to a dozen feet with a loess-like deposit. In considerable part it appears to be bedded in "ironstone," locally cemented gravel beds, which may be responsible in part for the preservation of such upland remnants as this.

The ridges are intricately dendritic in pattern, with a relief usually not exceeding two hundred feet. Nearly everywhere the slopes are strewn with gravel and chert fragments (Figure 54). The ridge tops are generally just wide enough for the old timber roads that wind along them (see at the right in Figure 55), and everywhere they have remained in forest.

The former flood plain of the river and the "hollow" floors of the tributaries are merged into one general slope. The large size of the lower portions of the hollows (Figure 56) is out of

[4] DeFriese, L. H., Timber and Botany (B), Geol. Surv. Ky. (1884), p. 112.

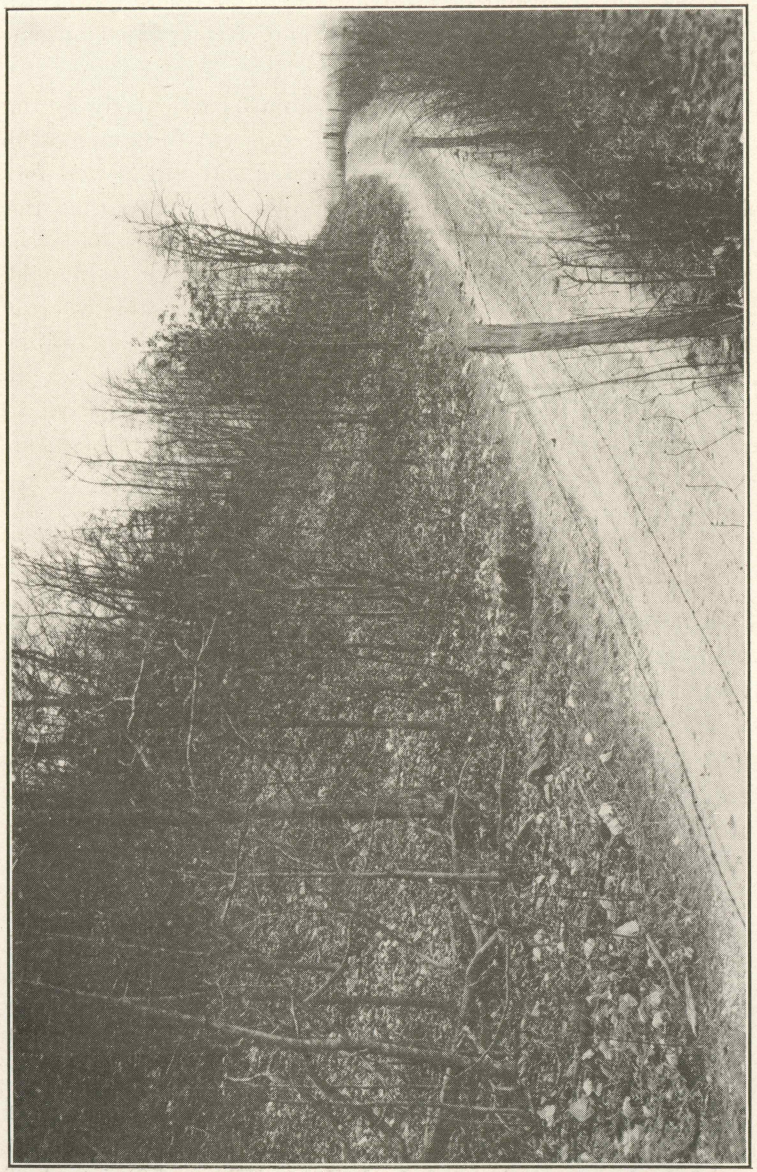


FIG. 54. GRAVEL AND CHERT-STREWN SLOPE.
This view is in the Gardener Hollow section, along margin of river flood plain.

all proportion to their present meagre flooding ability and identifies them as formerly drowned areas, when the river stood at a higher level. Upstream, however, where the hollows narrow decidedly, the surface slope increases, and the soil is stony, the valley floors being here the normal expression of wash from the hills

A strange feature of the river margin is the sand shingle bar which is normally present at the debouchure of every hollow into the river flood plain. These bars uniformly extend upstream, parallel to the river. The tributary stream is displaced to the southward also where it leaves its own valley. These points of land are important sites for farmsteads and are well-known to the native population. They are in all respects normal spits such as one might expect to find develop in a heavily silting valley in which the water has backed up into the tributaries, except for the fact that they are on the wrong side of the hollow. The Cumberland on a small scale is forming precisely similar bars today at flood-stage where tributaries discharge into it, but they are reversed in position. The position of these old bars suggests the possibility of reversed flow in this portion of the Tennessee at one time. This local feature is another instance of the problems awaiting the geomorphologist in the western end of the Pennyroyal. It may possibly be associated with marginal bulging in the extra-glacial basin of the lower Ohio.

The old flood plain locally is only a few feet above the present flood-plain, which lies thirty to forty feet above normal water level and presents no features other than those described for the Tennessee bottoms in general.

The Mountain Margin

The mountain margin of the Pennyroyal is much elongated from northeast to southwest. Beyond its northern, or Knobs, margin is the most historic section of the Bluegrass. Southward it continues as the eastern part of the Highland Rim of Tennessee. To the east, the Mountains rise as a bold, greatly fretted escarpment. Westward the breaks and bottoms of the Cumberland and of Fishing Creek detach it fram the upland Pennyroyal which we have called the Greensburg Area.

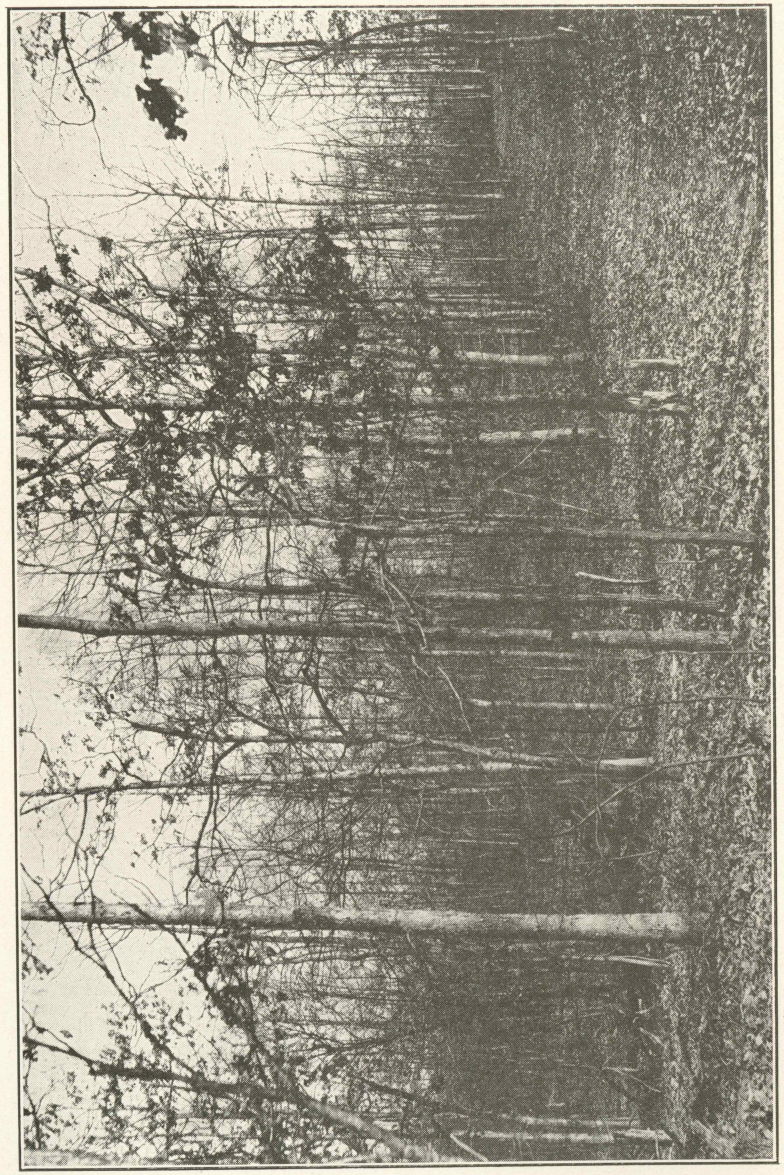


FIG. 55. AN OLD "HAUL-ROAD THROUGH SECOND-GROWTH TIMBER.
This view is in the Gardener Hollow section, on an extension of Jenny Ridge.

The area is in fact a narrow piedmont plateau flanking the western base of the Mountains. Mountain roads and trails descend onto it from the east by "cove" and ridge-spur. The Wilderness Road from Virginia, now largely paralleled by a line of the Louisville & Nashville from Stanford to Cumberland Gap,

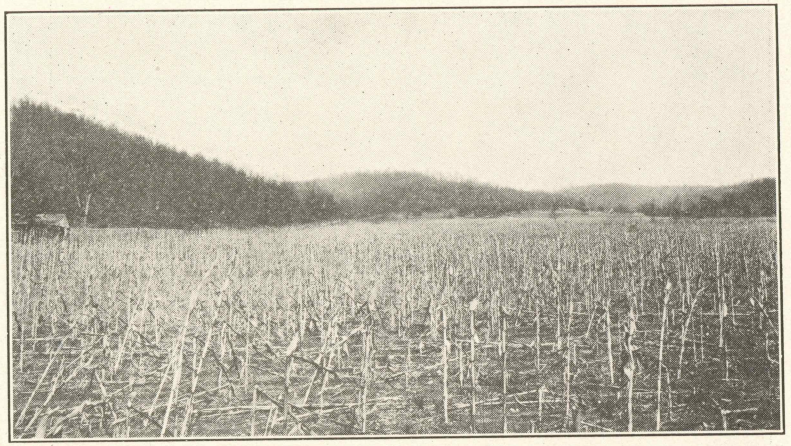


FIG. 56. LOOKING UP VANCE HOLLOW.
This view is in the Gardener Hollow section.

enters the northern end of this area near Mt. Vernon, and at the western limit of Rockcastle County makes the descent from the piedmont to the Bluegrass by way of Crab Orchard. The Queen and Crescent Railroad similarly, but for a longer distance, uses this intermediate region as a means of passing from Bluegrass to Mountains.

The area falls into three main divisions, that cut it into strips lengthwise: (1) The central part is a smooth to rolling upland of solution forms and reddish soil, underlain throughout by cavernous limestone and very similar to the Elizabethtown Area. (2) In the westernmost section, that is, adjacent to the Cumberland Valley, the shaly Waverly limestones form the surface. Heredissection by tributaries has been intricate, the width of the dissected belt growing steadily toward the Tennessee border. (3) The mountain contact consists of limestone valleys, usually ancient dolines, separated by ridges of mountain sandstones, in front of which are usually more or less detached outliners. The

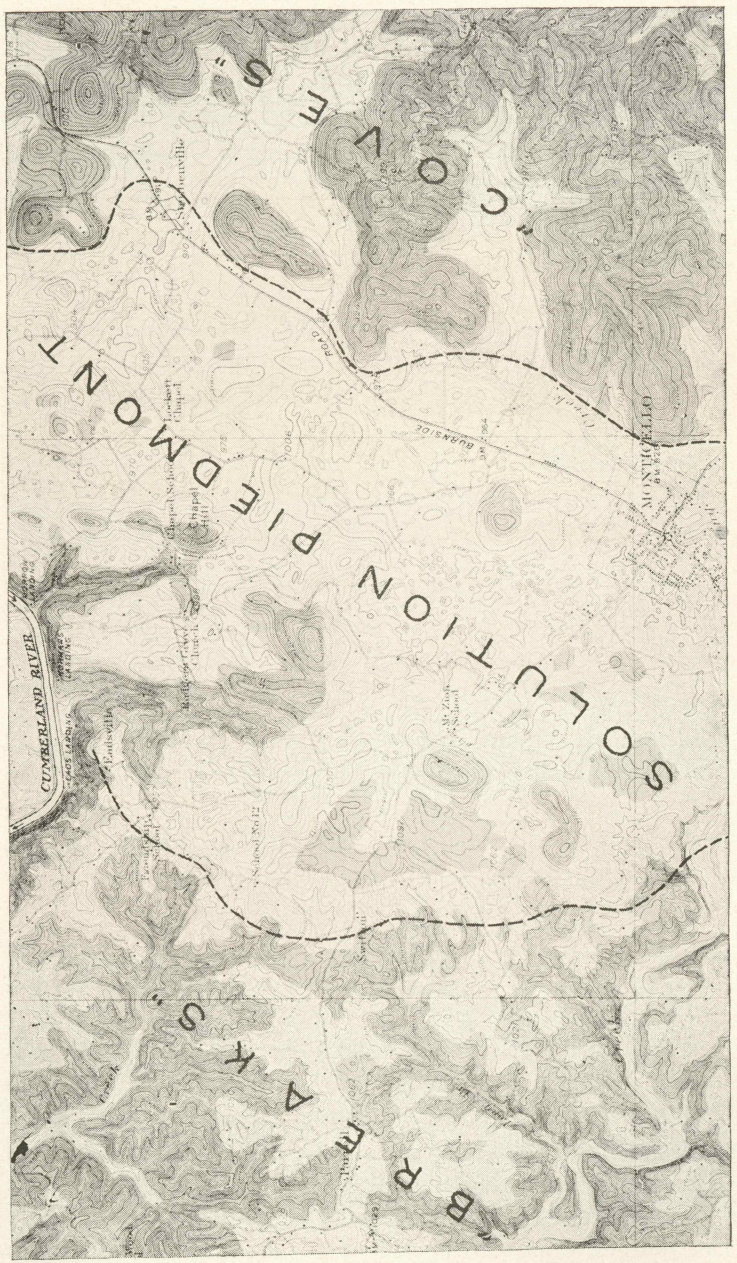
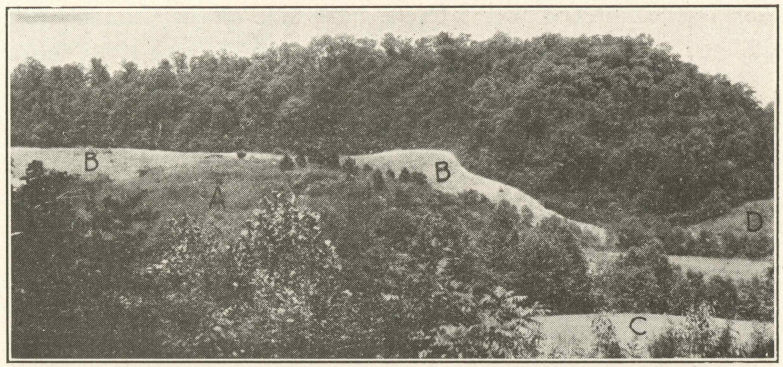


FIG. 57. A PORTION OF THE MONTICELLO TOPOGRAPHIC SHEET SHOWING "BREAKS," SOLUTION PIEDMONT" AND "COVES."

area as a whole therefore consists of a central strip of smooth and prosperous country breaking down westward into a very rough river-hill belt, and bordered at the east by mountain front, deeply penetrated by broad limestone valleys.



[1] Photograph by Stilgenbauer.

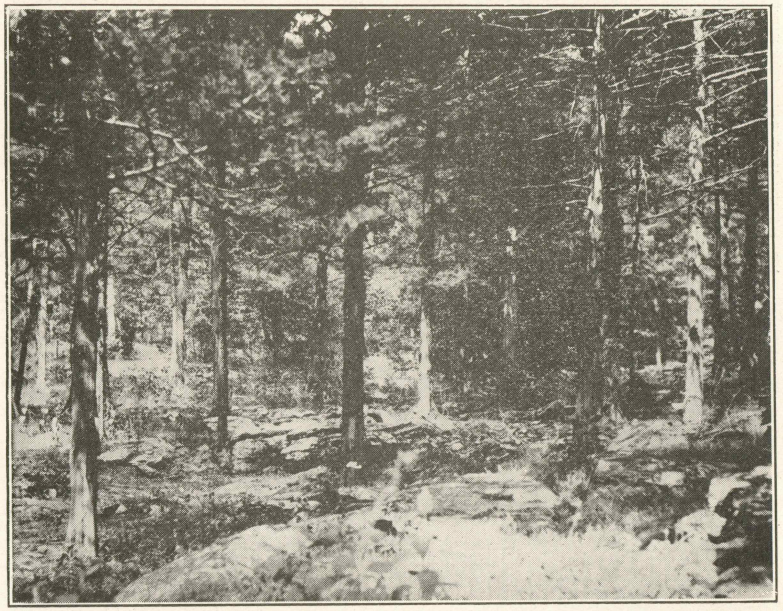
FIG. 58. VALLEY OF WHITE OAK CREEK.

Between this creek and its neighbors are narrow ridges thinly covered with cavernous limestone or without such a cap. The ridges are bordered throughout by valley slopes, several hundred feet high and densely forested, like the one in this illustration. This scene also shows in the foreground at the left (A) a detached knoll, or remnant of ground enclosed by a meander, beyond at B the outer rim of the former meander loop, at C the terrace that marks the old bed of the meander, and at D the present flood plain.

The broadest and smoothest part of the area lies along the Pulaski-Lincoln-Rockcastle county line. Here the streams flowing southward into the Cumberland have not yet dissected the upland extensively. Towns, such as Mt. Vernon, Waynesburg, and Eubank, therefore have about them extensive and good farming country.

A portion of the Monticello topographic sheet (Figure 57) shows all three subdivisions. The "breaks" of the Cumberland lie west and southwest of Eadsville. Here the red lands of the cavernous limestones form narrow strips on top of the main ridges, as about Parnell. These ridge tops are rolling and badly worn. Surface features, formed by solution, for the most part have been cut away. The unevenness of the ridge tops is not characteristic of Waverly materials, and its local prevalence marks the final dissection of a solution-shaped cavernous limestone surface. At this stage, when excessive lowering of the water table has made solution largely ineffective, the massive

bedding of the cavernous limestone and its position above shaly bers give rise to a more rugged surface than is characteristic in the dissection of the shaly limestone beds. The southern "breaks" of the Cumberland are therefore a rougher hill belt than is encountered on the Greensburg side of the Cumberland Valley. Valley bottoms are few and narrow. Rough ridge tops,



Photograph by Stilgenbauer.

Fig. 59. GLADE SLOPE ON A KNOLL.

This view shows a region east of the Conley store, on Meadow Creek. The lower part of the knoll, like most of its neighbors, contains several caves. The slopes of the knoll are principally ledges of glady limestones largely covered with red cedar.

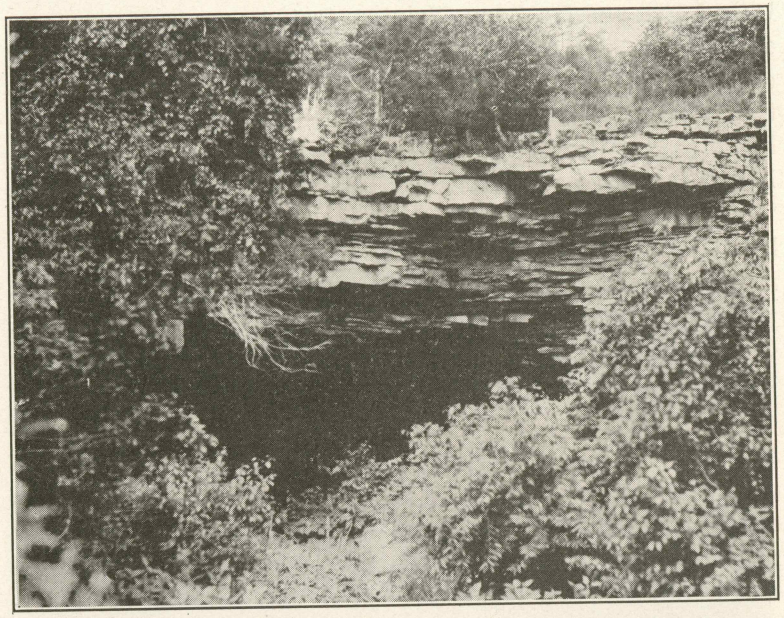
steep valley slopes, and small and isolated creek bottoms therefore combine to make the "breaks" of the Cumberland an area of very low attraction. (Figure 58.)

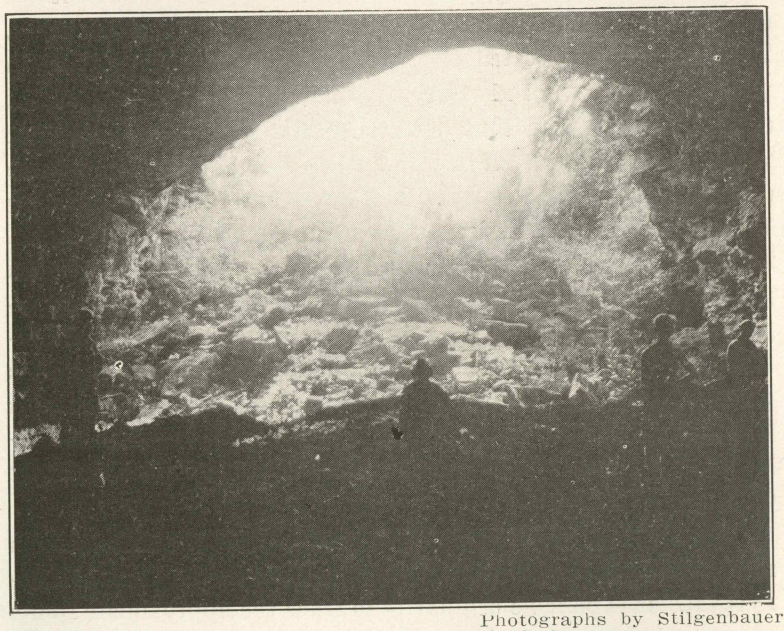
In contrast, the country along the Monticello-Burnside pike is very attractive. Eadsville, on the very edge of the Cumberland River, is almost at the same elevation as Monticello, five miles back from the river. This cavernous country does not slope toward streams; it is merely gashed by them. The smoothness of surface is interrupted principally by conical hills, such as

Chapel Hill and Mt. Zion. Solution features are very numerous on the plain, giving a pleasantly undulating appearance. For example the solution surface north of Monticello is almost entirely under cultivation and is little subject to slope wash. The knobs are capped for the most part by limestone ledges, appearing at the surface in numerous bleached slabs and forming a "glade" surface. The soil about their lower slopes commonly has a surface concentration of chert, known as "barren ground rock." On the higher slopes the soil is very thin; the ledges support on small patches of soil scattering red cedar. (Figures 59, 60 and 61.) Figure 62 shows the profile of one of the caves on the Hines property.

On the map are shown five knobs in a chain, extending south from Chapel Hill. They are obviously marginal to the solution basin north of Monticello and associated with it in origin. Knobs of this arrangement and location formed at one time apparently part of the Mountains. Their alignment parallel to the general mountain front and persistence all through the piedmont bordering the Mountains point to a gradual retreat of the mountain escarpment over a distance of from three to half a dozen miles. This retreat was effected by the sapping activity of solution in the limestone beds underlying the mountain sandstone. Great dolines were formed, similar to those that still exist to the east within the Mountains, as for example Big Sinking Valley. These dolines first coalesced as a series of coves like those now forming the contact between the limestone piedmont and the Mountains. The mountain ridges broke down and became knobs. The knobs gradually became so reduced that their sandstone cap disappeared. This central plain belt therefore is primarily solution-formed by the degradation of the mountain front, and in terms of solution cycle, is mature. The escarpment of the Mountains is still in process of being modified in the same way, by the removal of its limestone base and by the caving and washing away of the sandstone cap.

In the Mountain Margin sinks tend to align themselves much more definitely into dendritic patterns than in the Central Pennyroyal. It is possible ordinarily to trace the approximate limits of an underground drainage basin by the pattern of the sinks.





Photographs by Stilgenbauer.

FIGS. 60 AND 61. CAVE ENTRANCES NEAR MILL SPRINGS.

The principal local caves are not found beneath limestone plain but on the sides of the rounded knolls that rise above the plain and which are interpreted as remnants of former doline wall. The caves therefore lie mostly in the higher limestone beds, which are or were recently capped by sandstone.

This is probably due to the fact that most of the solution basins of this piedmont were well established as great dolines beneath the mountain sandstone before the present surface was formed. In the establishment of large-scale cavernous drainage the great depth of the Cumberland Valley no doubt was of considerable importance.

The soils of the central strip of the Mountain Margin are identical with those of the Central Pennyroyal. The best local limestone lands are as brown, mellow, and productive as the best tobacco lands about Hopkinsville. The reddish, rolling phase of the cavernous limestone soils is, however, the most abundant. Here the agricultural situation is far from good. The difference between optimum and crisis areas in the local uplands is a difference in slope.

"Flatwoods" areas appear to be more common and more extensive than in the Central Pennyroyal. One of the largest of these is that of Meadow Creek, halfway between Burnside and Monticello. It includes almost a thousand acres and extends quite to the base of the Mountains. About it lies a ring of knolls of medium height, pointing to its origin as a doline. Meadow Creek leaves the flatwoods basin by a subterranean passage between two knolls, the Burnside Pike crossing by the same saddle under which the creek flows. This underground outlet is not large enough to accommodate the flood-waters of Meadow Creek with their mountain drainage. After rains the water is backed up above the cavernous outlet for days, or even weeks. All of the flatwoods are formed by the blocking or partial blocking of their outlets, a contingency that is likely to happen to doline basins which receive torrential drainage and the washing in of much surface material. They are therefore a normal feature of the cove contact of the limestone piedmont with the mountain front. Their flat surfaces are the result of sedimentation, or of rock decay, not of accumulation of organic material. The soils are light-colored and very stiff clay, except about their margins. Some of these swamps are a chalk-colored clay to a depth of eight or ten feet, indicating a very long period of effective leaching.

The thickness of the cavernous limestones decreases westward from the mountain front, where they may be four hundred feet thick, to the frayed line where they give way to the underlying shaly limestones. East of Eadsville (shown on the map),

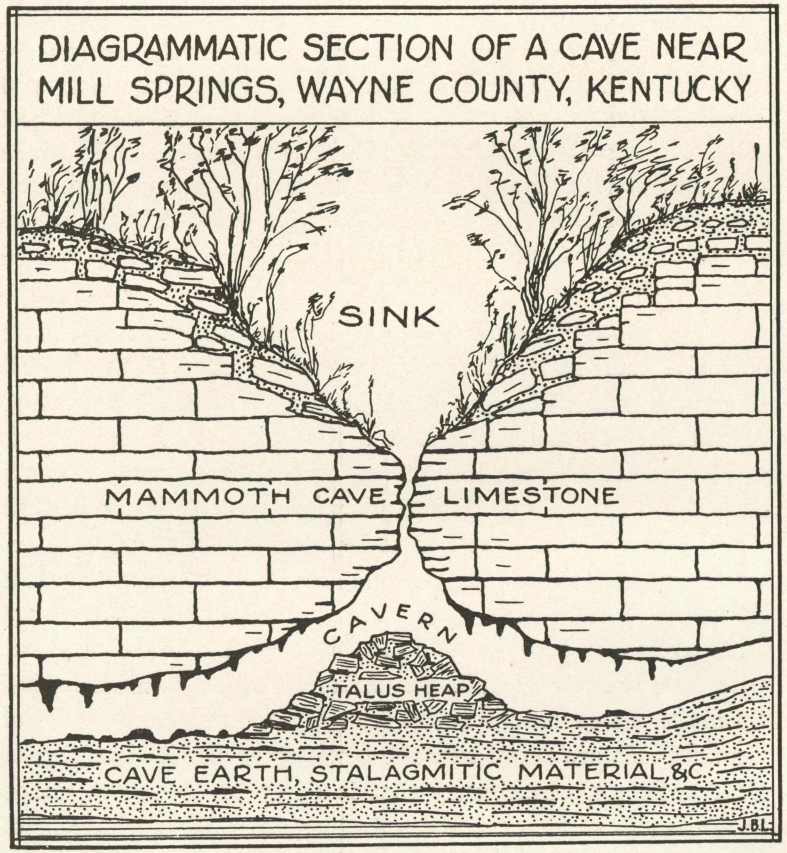


FIG. 62. DIAGRAMMATIC SECTION OF A CAVE NEAR MILL SPRINGS.

the Mammoth Cave limestones underlie the upland to a depth of scores of feet and dissection by surface streams is negligible for the most part. For a distance of about twenty miles from the place where it leaves the "Mountains," the Cumberland River flows across this limestone piedmont in a valley several hundred feet deep, but with almost no dissection along the valley margin.

Like the valleys of the Green and Barren rivers in the Pennyroyal Plain, the smooth limestone upland extends virtually to the river bluffs. In other words, not only the drainage of the limestone plain is underground, but most of the mountain run-off sinks underground into the cavernous horizon and thus goes to the river.

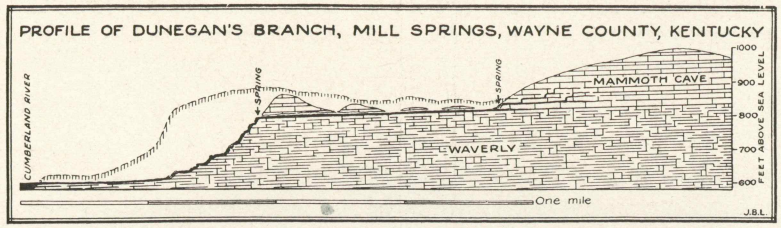


FIG. 63. PROFILE OF DUNNEGAN'S BRANCH, MILL SPRINGS.

The Cumberland River has numerous large springs, issuing on the valley bluffs at the base of the cavernous limestones or a little below that horizon on an impervious shale bed in the Waverly formation. Many of these springs discharge over the valley side, fully two hundred feet above river level, and form cascades or falls. Mostly, they carry virtually no sediment in dry weather but are somewhat subject to muddying during rains. They may be unfit for use for days during heavy rains and are subject to fairly large variations in volume. They take care of the run-off sufficiently largely so that surface streams are formed only in a very few places, even in heavy rain. A well-known large spring that collects the drainage from mountain hollows and ridges, probably for miles back of the limestone piedmont, is Mill Springs, halfway between Burnside and Monticello. It is sufficiently large to furnish power for grinding a large share of the grain of Wayne County. Within two miles up-river from this spring, on the same side of the valley, are nine more large high-level springs. One of these is shown in profile in Figure 63. The major spring issues from the base of a glady knoll into a sink, under which it passes, to reappear on the river bluffs in another sink, now largely destroyed by the headward erosion of the cascade which it forms.

Meadow Creek is in epitome the drainage form of the Mountain Margin. The creek discharges into Cumberland River just above Mill Springs. (1) In the last half mile of its course it receives the drainage from a number of springs that issue at the base of the cavernous limestones as noted above. Here the valley is deeply incised in the thin-bedded shaly limestones and forms a very picturesque glen, with falls, pools, and overhanging forest canopy (Figure 64). The creek bed rises to the spring level by a series of steps in the shaly bed-rock. Below the point of issuance of the springs, the valley has been partially blocked by great masses of calcareous tufa, a limy deposit formed by the aid of algae, vigorously overgrown with vegetation. Bed rock is almost completely concealed for many rods on the valley slopes by this drip-stone, through and over which the spring water seeps in a broadly extended sheet. The deposits are locally known as marl and are used to some extent as fertilizer because of their lime content and the ease with which the material is broken up by pick and shovel. (2) Above the major spring level, that is on the surface of cavernous limestone upland, the creek is an intermittent stream, or rather a series of pools at low water, in a shallow "meadow" valley, the water at rainless periods moving underground beneath the bed of the creek in large part. (3) Still farther upstream is the flatwoods area previously described and finally (4) the headwater drainage in the mountain front.

The term "rock-house" is applied locally to any conspicuously overhanging body of rock, sufficiently extensive to provide shelter for man or beast. A most impressive series of such overhangs is developed in the "breaks," approximately at the contact of the thick-bedded cavernous and the thin-bedded shaly limestones (Figure 65). The shaly beds on such steep slopes have weathered back under the massive beds and have sapped them to a considerable extent. Blocks have fallen down from above and ordinarily make a high talus rampart along the front of the rock-house, behind which the air may have an almost constant temperature. Some of the rock-houses along the Cumberland are forty rods or more in length and have a depth of thirty to fifty feet. They therefore served well as camp sites

for both Indians and whites, and at a later date as cellars and still sites.

The limestone valleys, coves, or hollows, that reach back, finger-like, into the foremost zone of the mountain ridges belong to the Mountain Margin of the Pennyroyal rather than to the

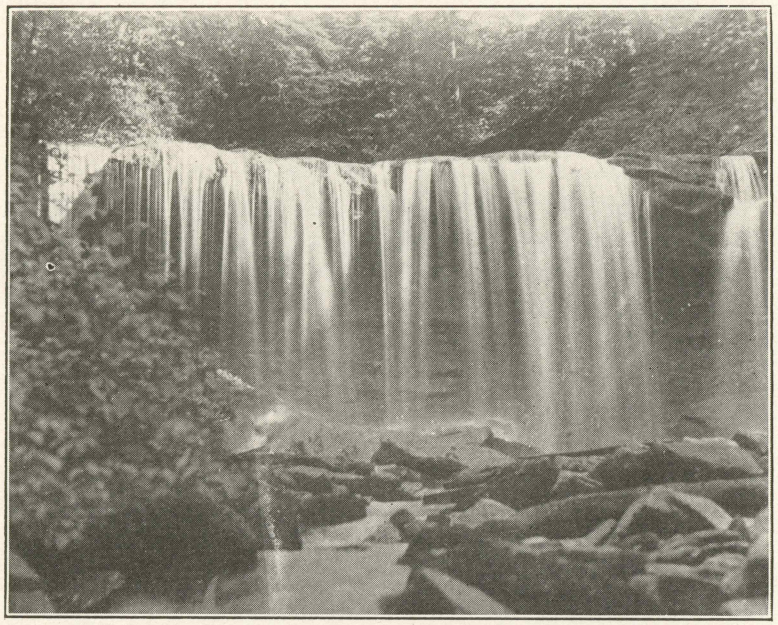


FIG 64. ONE OF THE FALLS OF MEADOW CREEK.
This is a spring-fed stream descending over the shaly limestones of the river bluffs by cascades and falls.

"Mountains." They have been characterized as less mature solution features of the same material as the piedmont belt. Their surfaces are more irregular than those of the piedmont and sinking streams are predominant. They are in general very wide as compared to their length and head abruptly. Elk Springs Valley, above Monticello (shown on Monticello topographic sheet) is an excellent example of such a cove. It is a mile wide in its widest part, which is three miles above its outlet into the piedmont. This valley has only interrupted surface drainage channels, in part having a reverse direction to the slope of the valley. The sandstone ridges abut sharply upon them. Glade

features ordinarily are wanting, due to the fact that waste from the sandstone ridges has concealed almost completely the limestones that lie well above the floor of the valley. The streams that come from the "Mountains" usually sink underground as

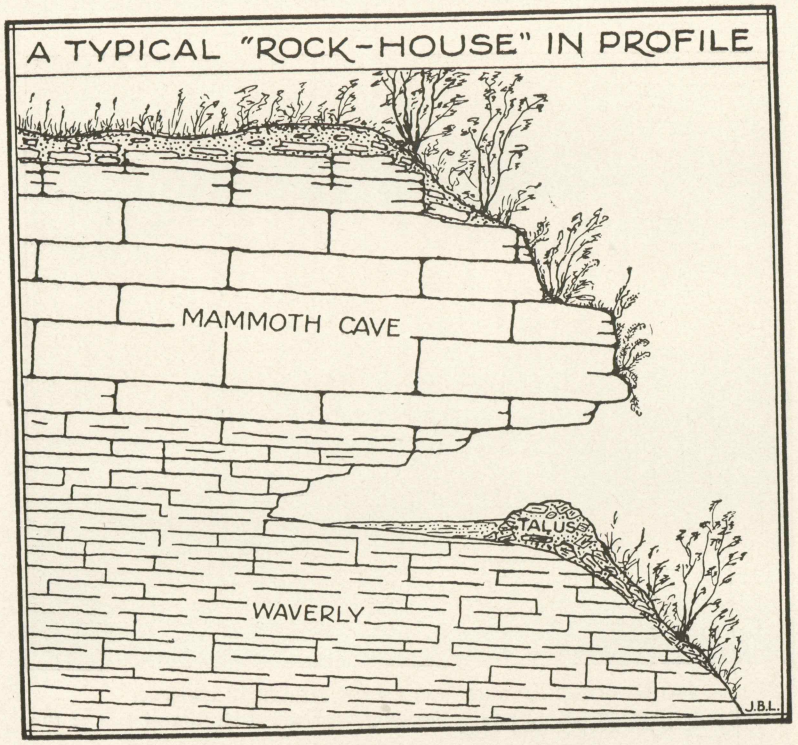


FIG. 65. A TYPICAL "ROCK HOUSE."

they reach the floor of the cove. The larger coves have reached maturity of solution surface and have very good land. The smaller ones are uneven as to floor, sandy as to soil, and less desirable.

The small cove communities are relatively isolated as to social life, and form compact groups, strongly intermarried and clannish. The commercial isolation of the Mountains, however, is not imposed on these people, since always a fairly good haul-road leads out to the big road that stretches along the limestone piedmont. The people on the other hand who live on the moun-

tain spurs, in small ridge-top groups, possibly within sight of the valley settlements, are confronted by the eternal problem of the Mountains, the heart-breaking grade between them and the world outside.

The cove margin of the Pennyroyal consists of a single chain of dolines at the eastern edge of the limestone plateau. Few of them are more than a half dozen miles long. Mostly they are much smaller. They are not to be confused with the larger dolines and limestone valleys completely enclosed by the Mountains, such as Rockcastle, Little South Fork and Big Sinking Fork of the Cumberland. These are true mountain valleys and communities, accessible only by crossing long ridges of mountain sandstone and by fording mountain streams. Their physical conditions are those of the other limestone areas, but their environment is that of the Mountains.

The Mountain Margin is the gateway to the world outside, such as it is, for the far distant communities back in the Mountains. It serves as piedmont areas usually do. The mountain people come down to Monticello, Somerset, and Mt. Vernon on their infrequent "trading" trips and to see the county town on court days, and on the "speaking" days of political campaigns, the gala days of the year. They also drift down from their fastnesses to try their fortunes, some because they think there is a greater chance outside, some because they think there is awaiting them on the plain a life of less effort. Mountain men are to be found almost everywhere through this area, as laborers and tenants, but also as community leaders. In fact the area is somewhat inclined to think of itself as a mountain region and it furnishes part of the mountain Republican vote. Thus do these Southern borderers reenact on a small scale the role that is played by highland borderers throughout the world.

CHAPTER SIX

NATURAL SUBDIVISIONS: THE CUMBERLAND ENCLAVE

The Diverse Cumberland Valley

Burnside is the upper gateway to the Cumberland. Above it, the river is a mountain stream with rapid water and with great masses of rock in its bed. Through the Mountains it has cut a rugged gorge back to its falls, the largest in the western versant of the Appalachians. Below Burnside the valley is a simple, only slightly sinuous trench, sunk directly beneath the limestone plateau of the Mountain Margin. It has a flood plain so narrow and subject to inundation that almost without exception its bottom is a single row of corn and hay fields belonging to adjacent upland farms, the farm buildings being set on the upland. The slopes are in minor part cliffs. Mostly they are well wooded. Here and there they have been cleared and are pastured. The lack of habitations in the valley gives to it a quality of loneliness that scarcely leads the river traveler to suspect the populous farming district that lies on the uplands hard against the river bluffs.

Fifteen miles below Burnside the river scene begins to change. Here, below the mouth of White Oak Creek, a broader, more undulating bottom begins on the right. Only a part of this bottom is flood plain. Within the valley walls lie short ridges and knolls of yellowish, clayey land, which contain shale fragments. Several farmhouses stand on the higher parts of this bottom, known as the Rankin Bottom. At its lower end, a larger bottom, Conley's, begins on the other bank. Behind it the river bluffs recede for more than half a mile; the higher "second" bottom is well developed. Here there is a small community, a number of farmhouses, a store, ferry, and post office, known to the Postal guide as Bud. The community knows itself by the name of Robertsport. Below this bottom the river begins its first great serpentine turn and great cliffs rise sheer two hundred feet above the water. Within this first great loop is the third named bottom, the Oats Bottom (Figure 66). It extends

for more than three miles along the left bank of the river. Across from it is Shinbone Cliff, one of the landmarks of the Cumberland. At least half of the bottom is not subject to flooding, but is formed of a gently rising slope of the yellowish clay first noted on the Rankin Bottom. This second bottom continues to the narrow stony ridge that lies within the river bend, a part of the general upland surface. The upstream side of this ridge is undercut by the river into a cliff; its downstream slope is furrowed by ravines. Its extremity declines toward the head of the river bend at a sufficiently gentle slope so that the road out of the Bottom leads over it.

The asymmetrical slopes of the ridge within the river loop, the position of the bottom land at the tip and on the downstream side of the ridge, the horseshoe-shaped cliff on the opposite side of the river, and especially the slopes intermediate between flood plain and ridge top,—all these are features of the valley, which below this point are repeated on an increasing scale by a series of bottoms, continuing in uninterrupted, staggered succession well into the Nashville Basin. Each bottom is situated within a crescentic river bend. As the bottom narrows downstream, a widening strip of bottom land appears on the other side. The river shortly crosses over to the other side of its valley and the position of the next bottom and its accompanying cliff is reversed. Each bottom holds a distinct community, bearing usually the name of the bottom, as for instance, Horseshoe Bottom and Puncheon Camp Bottom. The extraordinary individuality of these communities is related to the fact that each lies two to three hundred feet below the upland. The slopes between are for the most part sheer cliffs or rugged forested declivities, access to the upland ordinarily being restricted to roads that mount the tongue of upland within the river bend. One then continues, usually for miles, through a wooded dissected country before the smoother upland is reached. The bottom communities therefore are strongly isolated from the upland communities and have little contact with each other under existing conditions of river navigation.

The Incised Meanders of the Middle Cumberland

In part the Cumberland River has the normal features of maturity increasing downstream. In detail the features of the river are largely the expression of an unusual intrenchment. In particular the meanders have been extraordinarily enlarged, in part by the steepened gradient of the river, in part by very favorable conditions of bed rock.

Robertsport marks the limit between the Cumberland as a simple valley and as a distinctive area. Here the river has uncovered the weak shales that lie at the base of the Waverly formation. A short distance down-stream the limestone beds of the Silurian and Ordovician make their first appearance. All of these rocks are of low resistance. From these formations the Bluegrass and Nashville basins have been formed; the Cumberland is at work extending the Nashville Basin upstream. The river, having cut down to these beds, is able to widen its valley rapidly, especially because of the powerful tendency to cut laterally which it derives from its meandering course. The oblique resultant of the vertical and horizontal forces of erosion over which the Cumberland disposes, concentrates the attack of the stream effectively on the farthest ends of the river bends and widens them continually. The so-called second bottoms are in no small part rock terraces, but mostly they are not terraces of horizontal surface. They slope as a rule gradually toward the present flood plain and are caused by the diagonal entrenchment of the meanders. There is no definite break or slope separating the first and second bottoms.

Because of its mountain source the Cumberland is subject occasionally to very great freshets, rising at such times to fifty, sixty, or even more feet above its normal level. It is these great floods which bring down most of the sediment and are responsible for its general flood plain, forty to fifty feet above normal river level. In the greatest floods, parts of the valley are inundated which are not annually subject to flood. The river builds its plain only at flood stages, but it is continually at work degrading its bed. In many places the river flows directly on bed rock. Here shoals, or "riffles" are developed, steadily subject to corrasion. As it cuts down into the bed rock, parts of the

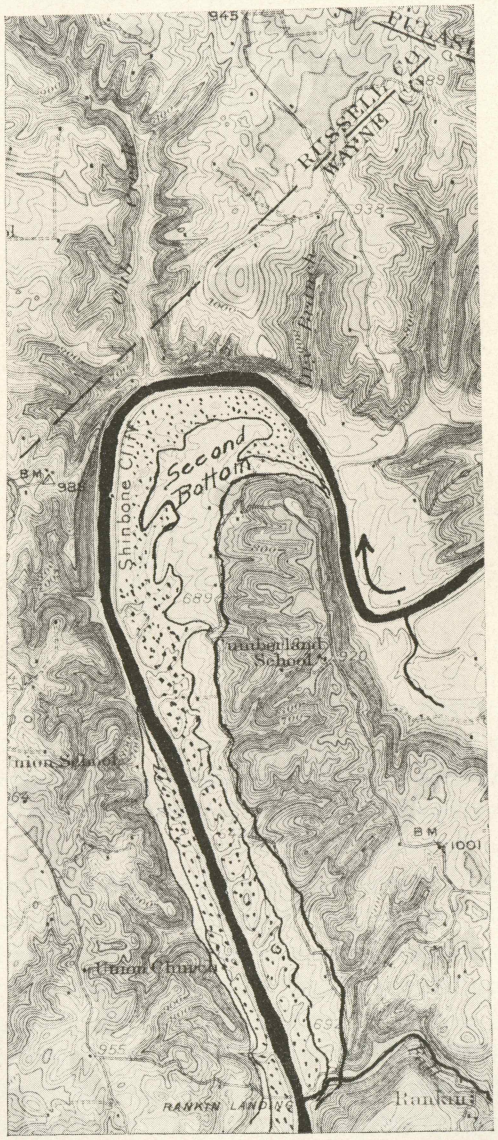


FIG. 66. MAP SHOWING THE CONFLUENCE OF CUB CREEK WITH THE CUMBERLAND RIVER.

flood plain become less and less frequently inundated and finally lie permanently above flood-level. This downward and lateral migration of the flood plain on the valley floor, the slip off process of river entrenchment, is largely responsible for the

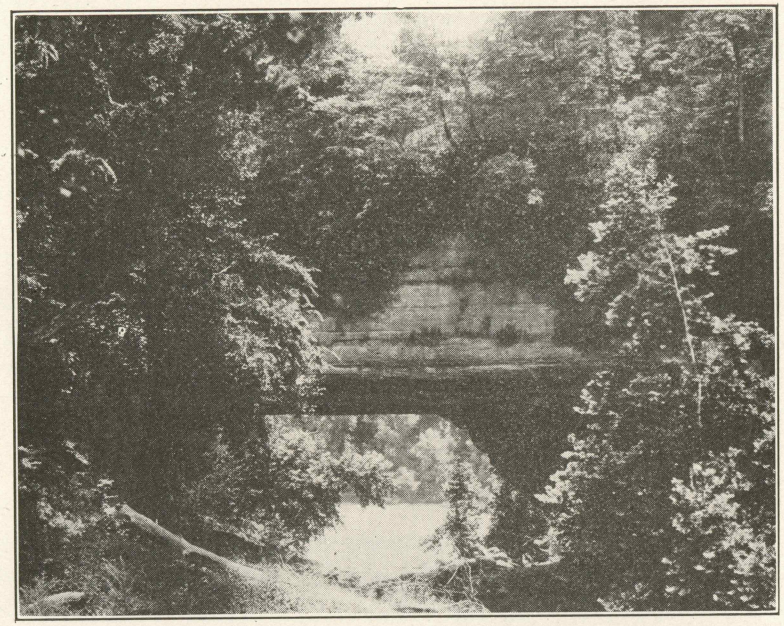


FIG. 67. NATURAL BRIDGE ON CUMBERLAND RIVER.
This view is from the small valley below Creelsboro. This wet weather stream flows under the natural bridge at the right.

second bottoms. This higher bottom is also partially built up by sheet-wash from the hills behind.

The soils of the second bottom are therefore of complex origin: (1) They are in part old flood plain material, as may be seen in the sandy fragments of ancient levees above present flood-level. (2) In part they are formed by the continued weathering of underlying shales and limestones. (3) In part they are colluvial, or formed by creep and wash from the hill slopes. These bottoms are locally quite variable, being notably derived from the basal shales in some places, in others bearing little evidence of residual origin. Mostly these second bottoms are fairly well leached, and are neither highly productive nor

infertile. The importance of the local weak basal rocks in the development of the great meanders is shown by the fact that such meanders are poorly developed on the upper river, where shales have not been uncovered.

The valley floor is predominantly composed of "second bottoms." The true flood plain, or first bottom, is a narrow fringe, rarely more than a quarter of a mile in width, except within the heads of the bends. A conspicuous feature of the first bottom is a pronounced and sandy levee, commonly ten to twelve feet high.

The very vigorous lateral growth of the meanders is further disclosed by several forms of disarrangement of the tributary drainage. Hanging valleys are common features of this section of the Cumberland Valley. Some of the tributaries join the main at normal grade, but many, especially at the head of the bends and immediately downstream therefrom, discharge over the bluffs in falls and cascades five to fifty feet high. At the head of the bends the lateral cutting of the river has been so great as to cut away the lower parts of the smaller tributaries.

A related feature is the great diversity of angle at which tributaries join the main stream. A number form very obtuse angles upstream with the Cumberland. Again the tributaries are likely to come into the main stream in clusters, the first with an unusually acute angle, the next at a normal angle, the third possibly at an obtuse angle. (Note the confluence of Cub Creek with the Cumberland on Figure 66).

A short distance above Creelsboro, on the south side of the river, is a well defined gap in the river bluff. This gap is formed by the encroachment of the Cumberland on the valley slope of a parallel flowing tributary, which it will in time divert. These are some of the locally common features of the lateral cutting of the Cumberland, which is truncating and even capturing its tributary drainage. The courses of the tributaries were established when the meander belt was much less wide than at present. Good topographic maps of the middle Cumberland would enable the approximate reconstruction from tributary drainage of the position of the river at the beginning of its rejuvenation.

Scenically the most interesting feature of the lateral migration of the Cumberland is supplied by the so-called "Rock-House," two miles below Creelsboro, not to be confused in type with the rockhouses previously described. The Creelsboro Rock-House is a natural bridge (Figure 67) on the edge of the river. The river is this point has driven the head of one of its bends so close to a parallel tributary valley that it has succeeded in breaking through the narrow interjacent wall at its base, still leaving the lower part of the ridge connected with the mainland by the natural bridge. The result has been the diversion of the tributary into the Cumberland through a channel under the bridge.[1] (Figure 68).

The scene from the top of the Rockhouse is one of the most memorable in the Cumberland Valley. Immediately below is a marvelously symmetrical horseshoe cliff, of which the river face of the Rockhouse forms a detail. On the opposite side of the river the valley floor rises gently by a long slip-off slope, until at a distance of about three miles the forest margin of the upland shuts off the view by its usual horizontal line. The bottom, including the slip-off slopes, is farmed.[2]

Some of the meander loops have been greatly narrowed at their base. One of these is further described in the type section, at Salt Lick Bend. The most pronounced example is Horseshoe Bottom, in Russell County. Here the river makes a swing of more than twelve miles, returning to a point less than half a mile

[1] Miller, loc. cit. pp. 212-213, gives hardly an adequate statement of the origin of the "Rockhouse." The origin of the feature appears rather to have been as follows: A small branch flows under the natural bridge except when floods in the Cumberland prevent. At such times some of the flood-waters of the river flow through under the bridge and down Back's Branch to rejoin the main river in the Irish Bottom. Before its capture by the Cumberland the small branch formed part of Back's Branch. Between the two streams now lies a dry valley floor, cut in rock, about 35 feet above the present creek level, which is the spillwater of Cumberland flood-waters mentioned above. The capture took place therefore when the original Back's Valley was about 35 feet above present river-level at the natural bridge. At that time the river could probably overflow a saddle, in shale, situated directly over the present natural bridge and still a well-marked feature. At flood stage it then cascaded into the little tributary and undercut the river-ward wall of the tributary by churn-drilling. The ridge was also being undercut by the river, cutting continually against the head of its bend, and, to a much lesser extent on the opposite side, by the creek. The bridge itself is cut entirely out of a massive and quite resistant limestone.

[2] Note the entry in John Muir's diary, made at Burkesville: "Burkesville, in beautiful location, is embosomed in a glorious array of verdant, flowing hills." The observer of such a scene will also understand the mood which Muir recorded at this time: "The Cumberland must be a happy stream. I think I should enjoy traveling with it in the midst of such beauty all my life." (Collected Works, vol. 1, pp. 257-58.)

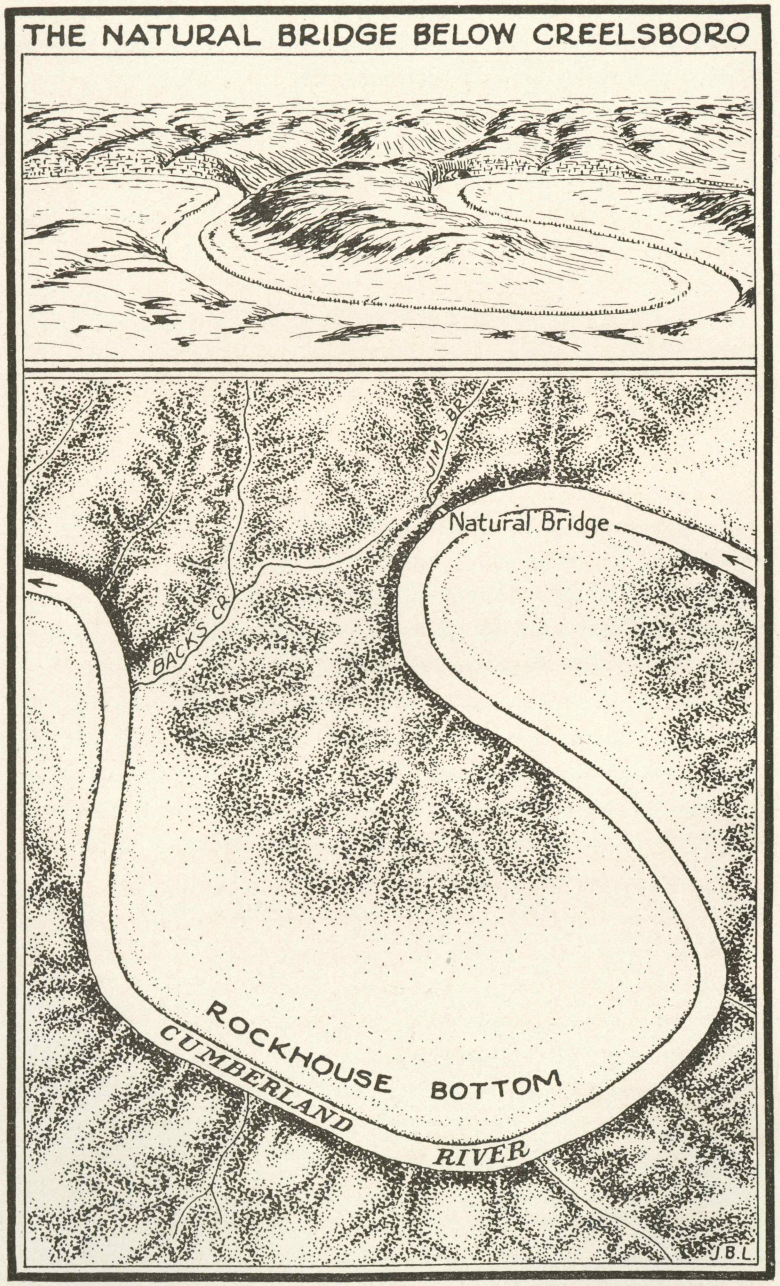


FIG. 68. THE NATURAL BRIDGE BELOW CREELSBORO.

from the beginning of the bend. On the bend are four shoals, including two of the most difficult places of swift water on the river. The shoals are limestone ledges over which the river flows in a broad, thin sheet. The amount of fall from the upper to the lower end of the bottom is estimated at about eighteen feet. In the neck of the bend is the usual ridge of the upland, here about two hundred and fifty feet high, forming a sheer cliff to the river on the upstream side. On the downstream side the slope at this narrowest place is on the average less than ten degrees.

Rock Formation and Valley Topography

The more fully the weak shales are exposed in the base of the valley the more accentuated is the relief form. It has been noted that the second bottoms vary in part with the extent of outcrop of these shales. Cliffs are steepest where the full thickness of the shales outcrop at the base of the river-cut bluff. In this case even partially overhanging cliffs may be formed. Small tributaries flowing on the shale horizon, with the more massive rock high up on the valley sides, have developed very narrow valleys. Due to the high jointing and fissile horizontal layers of these rocks, such streams are likely to have their beds on smooth black flags forming a series of low steps, with occasional sharply angular turns of the stream at the intersection with other joint planes.

The limestone beneath the black and ashy shales is quite massive (Richmond formation) and outcrops characteristically at the base of the river bluffs in a cliff, forming a very symmetrical asymptotic curve with the river surface. Tributary streambeds lying on this formation commonly expose long stretches of bare rock-flats, much used as roads. These rock surfaces are slippery when wet, hence sometimes known locally as "slick forks."

The Cumberland Enclave as a Distinctive Subdivision

The individuality of the Cumberland Valley below Robertsport is such that it is entitled to rank as a separate areal division. There are about twenty of the "big bottoms" in Kentucky, each holding a community. In most cases the upland behind them is dissected to such an extent that for a distance

of several miles on either side of the river the land is almost untilled and uninhabited except in the bottoms. Excepting for the main road up the slip-off slopes, the connections of the valley communities with upland are few and irregularly distributed. The river, except for mail service, is the connecting link be-

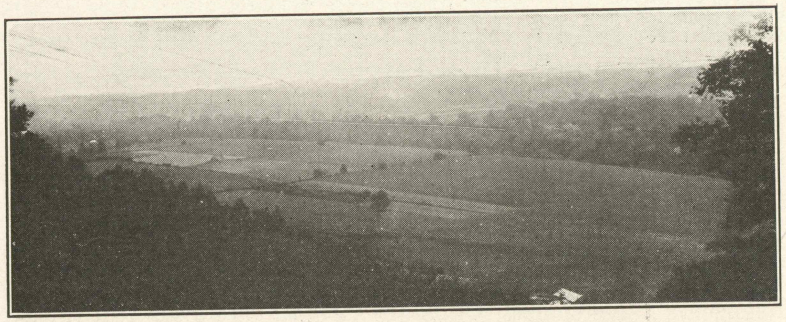


FIG. 69. SALT LICK BEND SECTION.
The upper part of the Bend, looking downstream. The ridge at the left is the narrow upland that extends into the middle of the Bend.

tween the bottom communities. The area is therefore unusually detached from the world outside and characterized by distinctive site problems. No other part of the state except parts of the Mountains is as little seen by outsiders. A few "drummers" and oil operators are almost the only outsiders who know the area. It is a strangely quiet and pleasant country, unlike in physical expression and conditions of life both to the upland Pennyroyal about it and to the Nashville Basin below. It is therefore designated here as an enclave, an alien area among the provinces of the Pennyroyal. Cumberland County is the only political unit to which the valley has given rise. It is typically a river county. About half the bottoms lie in this county and most of its productive area and population are concentrated within the meander belt.

Type Section for Cumberland Enclave

The third bottom above the Tennessee boundary is Salt Lick Bend, in western Cumberland County. Burkesville, the county seat, is seven miles distant by a characteristic road, leading along rocky stream beds and over washed ridge spurs, on which earth once cushioned the intervals between rock ledges.

Burkesville itself is forty miles from Glasgow, the nearest railroad point. The highway most used is the Cumberland, along which, in high water, steamboats ply between Nashville and Burnside. These carry the greater part of the goods entering and leaving the Bend.

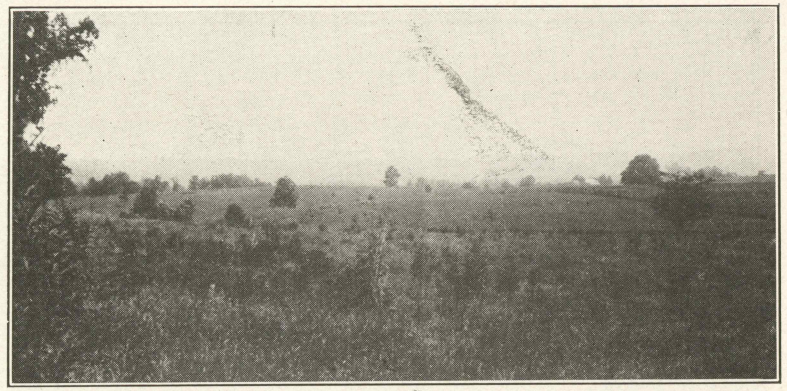


FIG. 70. PART OF THE "UPLAND" OR TERRACE SURFACE.
This view represents in the main an old valley fill, in the Salt Lick Bend section.

At its narrowest, the neck of the bend, known as "The Narrows," is a scant half mile across. The central ridge is from 250 to 300 feet high. The crest is broken by slight knolls, the highest of them formed of sandstone and having on them a thin, stony soil. The ridge extends about half-way through the Bend and has the usual slip-off slopes toward the head of the bend. Figure 69 gives a view of the upper half of the Bend, looking toward its head from the ridge.

The inner part of the crescentic valley floor is locally called the "Upland," the outer strip, bordering the river, "Bottom." The Upland is an old terrace, smooth topped, but fairly well dissected (Figure 70). The material is of alluvial origin, at its maximum depth fifty feet thick. Near its base is commonly a bed of gravel, the usual source of water for the wells of the community. The relative ease of movement of water through the soil and substratum has favored leaching. Ferruginous crusts have been exposed on washed surfaces. In places a solid stratum of impure limonite is exposed. On this and the other older bot-

toms of the lower part of the enclave, slip-off slopes are in part replaced by this intermediate more ancient bottom level.

The bottom is the area of the present alluviation. Most of it is overflowed at the time of the late winter and early spring freshets. The soil of the levees is sandy, the finest-textured soil

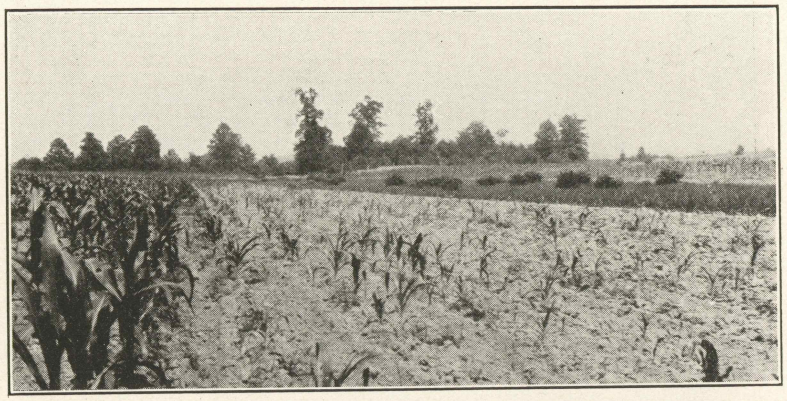


FIG. 71. "CRAWFISHY" LAND OF INNER EDGE OF BOTTOM.
This view is looking down one of the old stream beds, containing tight, low-grade soil, in the Salt Lick Bend section.

lying as usual along the inner border of the Bottom. This has poor drainage and is "crawfishy." (Figure 71.) In general the soils of the Bottom are very productive. Though they have been under cultivation without fertilizer for more than a century, the corn grown would be considered good in the best prairie sections of the country.

Conditions of poor drainage, which have produced "crawfishy" soil on the Bottom have had similar results along the "branches" that flow down from the upland. The lateral migration of the Cumberland during the widening of the meander decreased the gradient of the tributaries within the bend, so that free drainage in these "branches" was hindered. The building of natural levees by the river increased further the difficulty of their discharge into the river. Hence they are deflected downstream until a favorable spot for their escape was found.

Figure 72 illustrates the physical conditions of the Salt Lick Bend

Explanation of the features shown on Fig. 72.

"BOTTOM."

1. Sandy Loam Bottom. The area mapped under this head includes the land covered by actively moving water at times of flood. The nature of its origin gives it a lighter texture than that of the other types of "bottom" land. Topographically, it comprises the natural levee of the river. The soil is a fine sandy loam, light yellowish brown in color. It is highly productive, and is especially prized because the open texture permits tillage earlier in the spring than on the finer textured soils of the other types.

2. Silt Loam Bottom. This type lies farther back from the river than the preceding, and is not generally subject to over-flow. It retains moisture in dry seasons better than the sandy loam.

3. Crawfishy Land. Though all of the crawfishy land mapped is not included in the "bottom" in the strict sense, it is placed in that general category, as it belongs to the lower-lying group. It occurs in the poorly-drained swales which are former river courses, and along the courses of the small tributary streams, where drainage is poor. The commen charactertistic of all is the dense, puddled structure developed as a result of poor drainage. Little of this land is cropped; where cleared, it furnishes good pasture even in dry summers. Much is still covered with timber, mostly beech.

4. Secondary Alluvium. Some of the small streams have deposited on the floors of depressions in the upland patches of recent alluvial-colluvial material, distinct from the other types mapped. The soil is a brown sandy loam, productive, but tending toward wetness in the largest area mapped, in the southeastern part of the Bend. The "crawfishy" character does not seem to develop on this type.

"UPLAND."

5. Old Dissected Alluvium. This is the normal type of "upland," or dissected terrace. The soil is a yellow-brown silty to sandy loam, reddish where washed. It is prized by the inhabitants about equally with the bottom, as it is free from the delay in tillage resulting from prolonged wetness in the spring.

6. Slip-off Slopes. This term designates the inner portion of the terrace, where the thin alluvial cover has been removed by erosion. The soil is thin, and contains many fragments of the underlying sandstone. It deteriorates quickly under cultivation, and is rapidly going out of use.

RIDGE:

7. Steep, Rocky Slopes. This type includes all the descent from the Ridge to the lower land, except that mapped as cliff. The declivity is for the most part steep, but is interrupted by a narrow bench formed on the shale which outcrops near the top of the ridge. There is a thin soil cover, the body of which is derived largely from the shale, but this is preserved only where the slopes are left in timber. Patches have been cleared and cultivated, but on these erosion is rapidly removing the soil.

8. Sandstone Ridgetop. The greater part of the ridgetop is formed by sandstones of the Waverly series. This is the youngest formation occurring in the area, and thus these surfaces are the highest. The soil is a yellow loam, containing many fragments of rock. The slopes of the knolls tend to be fairly steep, and wash badly. The land is going out of use rapidly.

9. Limestone Ridgetop. This type has the most favorable topography of all the ridge land, the crinoidal limestone tending to give

rise to a typical rolling solution surface. The limited area, however, and the residual effect of the overlying sandstones, decrease the effect of the favorable origin and lithological character.

10. Shale Ridgetop. One of the knobs into which the ridge breaks toward the west is capped by the Ohio-Sunbury shale, which gives rise to a poor yellow clay loam, full of shale fragments. Its value is negligible.

Erosion damage is most extensive on the steep slopes of the Ridge, where these slopes have been cleared and placed under cultivation. Most of the land thus damaged has gone out of cultivation, and is growing up to brush again. The destructive effect is most significant, however, on the "Upland," on land that care in handling might have preserved.

Hachures are used to indicate precipitous slopes of whatever height. The most marked cliffs are those near the river at the eastern end of the area, which are about 200 feet in height. The river is everywhere bordered by a steep cliff thirty-odd feet in height at low water.

"Pond" designates a solution depression filled with water. But one of these features occurs in the area, near Cloyd's Ferry. Here underground drainage has formed a passage through the limestone underneath the alluvium, an dthe water has removed the alluvial material from over the opening.

"Sink" is used in its usual sense, as meaning a solution depression through which surface drainage escapes. The only example of this class of features is found on the limestone ridgetop, near the likewise single example of "Basin," a sink the bottom of which has been filled with colluvial material, thus forming a small level patch lower than the surrounding topography.

The hachures on the opposite side of the river indicate the extent to which this side is formed by cliffs. At other points, the river is bordered by alluvial flats forming "bends" of the same type as that herein described.

CHAPTER SEVEN

THE BARRENS

Is There a Quality Judgment Involved in the Name "Barren?"

It is supposed that the westward migrating Southerners held a strong prejudice against treeless lands, that they avoided these lands in settlement, and left them in general to be occupied by later settlers from the North.[1] Certain it is that they, the first-comers in the prairie states, built their homes along the wooded valleys. Perhaps their avoidance of the prairie, however, was due to the fact that it presented a more serious problem to occupation than did the timbered lands. On this subject the settlement of the Pennyroyal sheds critical light.

The Pennyroyal was the first important body of grass land encountered in trans-Appalachian settlement. The seaboard South contained many but minor unforested patches, which held little difficulty for settlement. When the pioneer encountered the grassy plains of the Pennyroyal, he promptly called them "barrens." The same designation was given in part to the prairie areas in Missouri, when shortly after the Kentuckian became the pioneer settler in that state. The term also had some currency in Illinois. In both of the latter states, however, it was soon replaced by the local French term "Prairie." When Kentucky was settled, the Americans did not know the word "prairie." Did the name "barren," as commonly thought, imply adverse judgment of the grassy Pennyroyal?

The manner of settlement, referred to in the following chapter, gives the most conclusive answer to the question. The following citations indicate, moreover, that the local barrens were so-called rather to indicate that they were bare of the usual forest cover than because they were thought to be unproductive or infertile We have indeed in our language no English word that is descriptive of grasslands, excepting for such special types as "barrens," "meadows," and "glades." Although properly descriptive of very different site conditions it appears that all

[1] Sauer, Upper Illinois Valley, Ill. Geol. Surv. Bull. 27, pp. 153-56.

three of these terms were used more or less interchangeably in Kentucky, the designation "barrens" gaining the greatest currency. The name is, therefore, considered as the result of a dilemma of language rather than as a judgment of fertility.

Filson's well-known map of 1784 has written across the area between the Green and Salt rivers: "Here is an extensive tract, call'd Green River Plains, which produces no Timber, and but little Water; mostly Fertile, and cover'd with excellent Grass and Herbage." This statement of luxuriance of prairie growth, fertility of soil, and lack of surface water shows a correct and far from unfavorable judgment of the area. In the printed account of the same year Filson uses the term "Green river barrens," apparently not considering it in contradiction to his map.

Gilbert Imlay, Land Commissioner in the Back Settlements, in his account, dated about 1792, gives the report of one supposedly familiar with the country as a competent judge of land. He makes the following significant observations: (1) That to the south of the Ohio in the Elizabethtown Area of this study, "is a considerable extent of fine land;" (2) "but traveling a few leagues farther southward, you arrive at extensive plains, which stretch upwards of one hundred and fifty miles in a southwest course, and end only when they join the mountainious country." This curious topographic note may refer to the "breaks" of the Tennessee River in the western part of the state. (3) As to the quality of the land his judgment is confused and, in terms of topography, somewhat contradictory. In one passage he affirms that the plain country "is considered little better than barren land," but adds in the same paragraph, "yet it is of a superior quality to much of the soil in the lower parts of Virginia, the Carolinas, and Georgia." He points out the abundance of hazel, "which, it is well known, never grows kindly in a poor soil," of grapes, and of other fruit. He then affirms that the land between the Green and the Cumberland, which actually is a part of the plains referred to above under 2, is generally rich. His general opinion of the areas which he seems to have known at first hand is rather favorable.[2]

[2] Topographical Description, pp. 35-37.

The Elihu Barker map of about 1792, reproduced in Imlay's Topography shows (1) a tract of "Barrens" between the Big and Little Barren Rivers, (2) "Barren and Naked Land" in Crittenden and Livingston counties, (3) an area of "Glades" south of Crab Orchard, and (4) "very good land" on the grassy upland of southern Pulaski County.

Jedediah Morse, first American geographic compiler, made the following statement in the American Gazetteer of 1797: "Between the mouth of the Green river and Salt river, a distance of nearly 200 miles, the land upon the banks of the Ohio are generally fertile and rich; but, leaving its banks, you fall into the plain country, which is considered as little better than barren land.[3] . . . N. W. of Rolling Fork, a branch of the Salt river, is a tract of about 40 square miles, mostly barren, interspersed with plains and strips of good land, which are advantageous situations for raising cattle, as the neighboring barrens, as they are improperly styled, are covered with grass, and afford good pasturage." Evidently the compiler missed the identity of barrens and plains and became wound up in considerable confusion.

In 1817 the grassy lands south of Russellville, fifteen by ninety miles in extent, were stated to be:: "prairies . . . rich, finely watered, and . . . sufficient to maintain an immense population."[4] Timothy Flint, in 1832 said: "Between the Rolling Fork of Salt river and Green river is a very extensive tract, called 'barrens.' The soil is generally good, though not of the first quality. Between Green and Cumberland rivers is a still larger tracts of 'Barrens.' "[5]

The designation of the grass lands as "meadows" appears to have been customary principally in the Mountain Margin. Possibly this referred to a rather wet surface, as the name would imply. It is not certain that such was the case, however, as the really wet lands are "flatwoods," and probably were such at time of settlement. Wayne County received its first settlement shortly after 1780 on the limestone piedmont at Price's Meadow, the

[3] Note the language of Imlay reappearing in the Gazetteer.
[4] Brown, Western Gazetteer, pp. 105-06.
[5] History and Geography of the Mississippi Valley, p. 347.

local stream still being known as Meadow Creek.[6] The term "glade" was also used somewhat in the Mountain Margin, to designate grass-lands partially enclosed by forest, smooth lands at the eastern edge of the limestone plateau. This term suggests an explanation for the "cedar glades" of today. In Kentucky and Missouri the term glade is now used to characterize slopes of thin soil, covered with cedar and scant grass. They are demonstrably located in numerous cases on limestone knolls and cove slopes that were originally bare of forest cover, or nearly so according to local tradition and the evidence of the forest growth. They were parts of larger grassy glades, which were for the most part put under cultivation. The marginal areas of this soil, however, were occupied by cedar after a time, cedar being the most vigorous old-field growth together with sassafras and persimmon, both also found on such sites, and therefore the vanguard of the forest. These grassy glades became "cedar glades." The normal use of the term "glade" for grassland has disappeared entirely in Kentucky, though it existed a century ago.

Nature of the Original Vegetation

The smooth parts of the Pennyroyal were originally prairie, largely blue-stem grass. The grass-lands "were adorned with islets or intersected by groves of timber."[7] "The country, sparsely clad with trees, is covered with grass like a prairie."[8] "Some few clumps of trees, and a grove here and there, are the only obstructions to a boundless horizon. It is pleasant to observe the deer bounding over the scraggy shrubs which cover the earth,"[9] adds Imlay with his penchant for confusing our idea of the local scene. According to oral accounts groves of large trees were not uncommon, but not extensive, on the smooth upland. The valleys were forested, for the most part heavily so.

Origin of the Barrens

The local grass-lands were surrounded by an area of most luxuriant forest growth. In few parts of the country is a more

[6] Miller, in Ky. Geol, Surv., Ser. VI, vol. 10, pp. 109–110.
[7] Brown, Western Gazetteer, pp. 106-06, also pp. 83–84.
[8] Flint, loc. cit.
[9] Imlay, loc. cit.

diversified hardwood forest to be found than in the lower Ohio Valley. Louisville, Cincinnati, Evansville, and Nashville, were famous lumber markets in the early days and still draw high-quality logs from their surrounding areas. Memphis is the greatest primary hardwood market in the world today. The Mississippi lowlands, the hill country of the Western Coal Basin, the Knobs, and the Mountains were covered with a splendid growth of giant trees which completely surrounded the Barrens.

The valleys within the Pennyroyal were heavily forested. Audubon found enormous pigeon roosts in the Pennyroyal along the Green River, which betokened extensive forests.[10] The breaks of the Cumberland and of the lesser streams were covered by heavy forests of old growth. There is nothing in the distribution of forests in this part of the country to suggest that climate or the history of forest migration could explain the lack of forests in the Pennyroyal uplands. Indeed, eastern forest trees, such as the beech are to be found beyond the western border of the Pennyroyal, and southern forest trees, such as the cypress and cucumber tree, have pushed their way northward beyond this region. The area was not intermediate between two or more forest zones that had not yet met. It cannot, therefore, be regarded as a relic grass-land, but must be considered as an area in which edaphic conditions were unsuited to tree growth, or one that had become deforested, in which the forest islands and tongues were remnants of a vanished forest, not outposts of an invading forest.

The partial correlation between grass-land and cavernous limestones has suggested a casual connection between the nature of soil and vegetation. This was expressed at an early date by Owen, who said: "It is altogether probable that there was a peculiar tendency in the soil to produce that luxuriant growth of barren grass which took possession of the soil, to the exclusion of all timber, and which is described as having attained a heighth of five to six feet."[11] He offers this, however, only as a partial explanation of the grassy condition. The smoother parts of the Greensburg area, underlain by the Waverly limestones, appear however to have been similarly grass-covered, and dissected por-

[10] Birds of North America, vol. 5, pp. 27–30.
[11] Ky. Geol. Surv., vol. 1 (1854–55), p. 84.

tions of the cavernous limestones were generally tree-covered. The correlation appears to be entirely with topography, the lack of forest growth on the cavernous limestones resulting from the smoothness of their surface.

There is popular unanimity in ascribing the barrens to fires. Fires were set, first by Indians, later by whites, in order to improve grazing, and in part, in order to drive game. Fires burn against the slope. They spread readily over a smooth surface, but normally will not descend a steep valley, unless driven by a very favorable wind. The smooth lands, probably containing a mature forest with little undergrowth, were gradually cleared, by oft-repeated burning, of most of their timber.[12]

We have here probably an illustration on a large scale of the fact that even primitive man is able to modify profoundly his environment by the aid of his most powerful tool, fire. That fires had been sweeping these lands for a long time is abundantly attested. That the Indians were in habit of setting fires has not been disputed. What the original condition of the forest was, is not known. It probably was an open, mature forest, under which grass and herbage grew at least fairly well. The area, quite unoccupied at settlement by resident Indian tribes, appears to have been at an earlier date the home of a numerous population, possibly for a very long time. Along the valley

[12] Owen, loc. cit., pp, 83-84, reported the opinion of the natives seventy years ago as follows: "They generally attribute this change to the wild fires which formerly used to sweep over the whole country, in dry seasons, being now, for the most part, avoided or subdued, if by accident they should break out. No timber appears to be capable of surviving the scorching effect of such fires, but the thick-barked black-jack oak, which, here and there resisting its ravages, stood solitary monuments of its hardy nature, and the blasting influence of the prairie fire." Shaler, 12th Ann. Rep. U. S. G. S., Pt. 1, pp. 324-325, made the following statement: "While the Indians used this region as a hunting ground, the district between Louisville and the Tennessee line, extending thence westerly along the southern border of Kentucky to the Cumberland River, was mostly in the condition of prairies. Except near the streams and on the margins of this so-called 'barren district,' the forests were scarred by fire. There were no young trees springing up to take the place of the old and thick-barked veterans of the wood, which from the hardness of their outer coating could resist flame. When these mature trees died they had no succession and so the prairie ground became gradually extended over the area originally occupied by the forest. After the Indians were driven away, about 50 years elapsed before the country was generally settled, and in this period the woods to a considerable extent recovered possession of the areas of open ground. The periodic firing of the grass having ceased, seeds were disseminated from the scattered clumps of wood, and soon made them the centers of swiftly spreading plantations. It was the opinion of the late Senator Underwood, who had seen this country in the first years of the present century and who was a most intelligent observer, that the timberless character of this district was entirely due to the habit which the aborigines had of firing the grasses in the open ground." See also Hussey, Geol. Surv. Ky. (1884), Pt. B, p. 35.

margins are extraordinarily numerous indications of aboriginal population. Burial grounds, mounds, heaps of spalls, stone implements and weapons scattered through fields and along roadsides and discoverable after every heavy rain, kitchen middens under rock shelters, the very quantity of ruins and debris left behind in this area point to an unusually important archaelogic site. It is perhaps significant that the Ozarks, which present similar records of ancient and important aboriginal population, also show the same feature of deforested upland flats, though their geologic formations are very different from the Pennyroyal.[13] Perhaps in both cases we are dealing with a primitive cultural landscape in these grass-lands, due to unusual length of aboriginal occupation, and to the greater ease of modification of vegetation in an area of smooth uplands than in a region of more diversified relief. Was the upper margin of the interior Mesothermal climate the site of an important early, potamic culture of which the barrens like the great mounds of the Mississippi and Missouri Valleys are witnesses? Though amateur collecting is wiping out more and more the Indian relics, it is perhaps still possible by field study to determine the extent to which the area contained in aboriginal culture antedating the homesteads of the Shawnees who were the last Indian residents (presumably dislodged from this area at the beginning of the 18th century).

The Reintroduction of Forests

All accounts later than the first quarter of the Nineteenth Century refer to the barrens as a past or passing condition. Thus Davenport, about 1830, speaks of "a few years since, a beautiful prairie . . . now covered with a young growth of various kinds of trees. These, however, do not prevent the growth of grass."[14] In 1833 it was said: "Here the hills are isolated knobs, wooded with oak, chestnut, and elm. . . . The soil is far from barren though much of the timber has a stunted appearance." The country near the Cumberland Valley "has been transformed within a few years from an extended and unbroken prairie into forests of thrifty and valuable timber."[15] In 1853 is was claimed that the upper Green basin was still

[13] Sauer, Geography of the Ozark Highland (1920), pp. 53-55.
[14] Gazetteer, p. 130.
[15] Darby and Dwight, Gazetteer, article on Kentucky.

"thinly wooded, and covered in summer with grass growing amid scattered and stunted oaks."[16] Owen reported in 1855: "Since the settlement of the country this grass has become almost extinct whereby opportunity has been afforded for timber to take root and flourish."[17] John Muir, in his foot tour of 1867 across the middle Green and Cumberland valleys, reported black oaks, "many of which were sixty or seventy feet in height, and are said to have grown since the fires were kept off, forty years ago."[18] Hussey in 1875 still remarked upon the poverty of the forest floras in Barren County, a condition that is hardly noticeable at present.[19]

These various accounts suggest the following association of events: the suppression of fires through settlement, the deterioration of the wild sod through grazing and its destruction by the plow, the spread of forest from valley sides and upland copses, and the gradual immigration of more numerous forest species. Today the land that is not cultivated is well covered with trees. Knolls on the plains, swampy flatwoods, worn pastures, and abandoned fields are the forest sites of the present. The rapidity of forest invasion in the past century indicates that the checks upon it previously were not those of climate or soil. For the second time man appears to have changed fundamentally vegetational formation of the area. The Pennyroyal would be a fruitful field for careful ecologic study to determine whether the stage of forest succession has again reached equality with the forested areas round about. The local prevalence of red cedar on thin slopes appears to indicate that an early stage of forest invasion is still characteristic of parts of the area. The local tradition is that the stands of cedar are very much more extensive than they were even a half century ago.

[16] Fisher, R. S., Gazetteer, p. 344.
[17] Loc. cit., p. 84.
[18] Collected Works, vol. 1, p. 251.
[19] Ky. Geol. Surv., 1884, Pt. B, p. 34.

CHAPTER EIGHT

ATTRACTIONS OF THE REGION TO SETTLEMENT

The Place of Historical Geography

The physical pattern of the landscape has been considered at some length. The cultural conditions of the area remain to be placed in relation to the physical equipment. Bacon long ago gave the key to the relation of cultural to natural landscape in saying that only he rules over nature who knows how to obey it. Every farmer knows that different fields need different management. Foresters speak of differences in "site quality" of land for various trees. There are similar differences in site quality for the growth of cultures. It is necessary to remember that the area is culturally expressed as well by the interests and enterprise of the people as by its natural resources. The people use the area and transform it; the area merely sets limits. To understand an area as a cultural site we need, therefore, to know who settled it, when it was settled, and how.

Subsequent chapters will treat of present cultural patterns and site qualities. This chapter is concerned with the early attractions of the area, which determined the character of its settlement. These conditions have disappeared largely and have been replaced by others. However the population of the region today is descended almost entirely from the original group of settlers. In this section the past is still potent both in the heritage of blood and in the preservation of traditional attitudes

Growth of Population

The growth of population is shown in Figure 73. In 1780 the region was virtually uninhabited. By 1790 there were four or five thousand people in the Pennyroyal. Thereafter the growth was rapid until 1820. In this first period there were between one hundred and a hundred and twenty-five thousand immigrants into the area, surely in itself an answer to the question what the pioneers thought of the "Barren Grounds"! Thereafter population increase was but slightly supported by immigration of white farmers. Almost all of the present stock

of the area was introduced more than a century ago. The time of major settlement therefore coincides largely with the general period of settlement of Kentucky, but the period of immigration

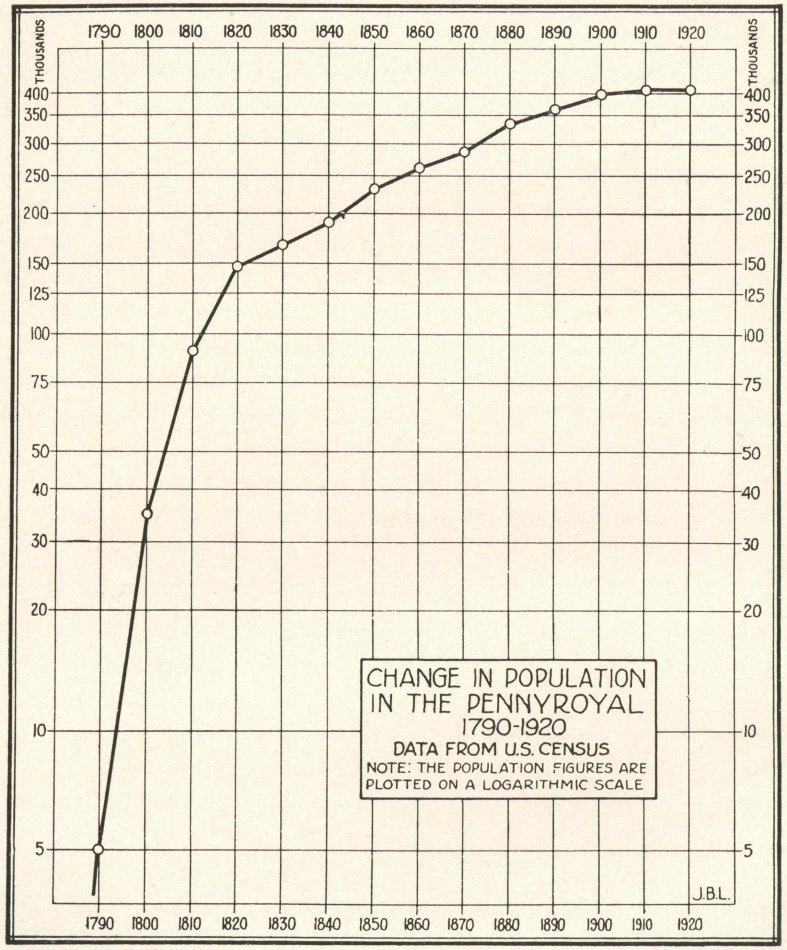


FIG. 73. GRAPH SHOWING CHANGE IN POPULATION IN THE PENNYROYAL, 1790-1920.

stops at an earlier date than in some of the other sections of the state. In 1820 this area held 26 per cent. of the population of the state. It has never been relatively as important, before or since that date. A region was certainly not in disrepute that received more than a hundred thousand settlers in the first period

of western colonization and had within thirty years an average of three to four homesteads to every square mile of land surface. The general westward movement of population spread symmetrically and rapidly across the Pennyroyal and thence beyond the area to the trans-Mississippi county. The grass lands of the Pennyroyal did not delay settlement. Once settlement was under way they were occupied somewhat more rapidly and fully than were other areas of more varied resource.

A second, very minor period of increased growth took place between 1840 and 1860, due to the extension of tobacco growing and the increase of slaveholding. In 1860 almost one-fourth of the population was negro. Today it is about one-eighth. Another period of somewhat stimulated growth was around 1880, caused by the building of railroads and the growth of towns. Both of these periods brought relatively small numbers of people into the area, the former negroes to the plantations, the latter new settlers into the towns.

Until 1900 the amount of emigration from the area was slight. Since then the population has been virtually stationary, indicating that in that time perhaps almost a hundred thousand people, the normal surplus of birth over deaths, have quitted the area. It should be added that this situation indicates a rather unusual tenacity to the home area for an American rural population. It is matched by adjacent southern regions, but distinctly different from the older rural sections of the North.

The Choice of Location

The local population has not been much given to the writing of biographies or of local histories. Its lack of self-expression in these regards is characteristic of the Southern frontiersman, whose interests did not run to letters, and whose consciousness of his lineage was not sharpened by the intrusion of later comers. Every one was an "old settler" and all had a similar history. Thus there was little need felt to record the annals of the frontier. Fortunately, the industry of Lewis and Richard Collins, Kentuckians of the Bluegrass, has preserved in their History of Kentucky numerous items, indeed much of what is known about the settlement of the region. This source has been used freely in the following pages.

The area was the connecting link between the thriving settlements of the Bluegrass and the almost equally vigorous settlements of the Nashville Basin. Both had been entered and colonized from the Great Appalachian Valley. All the commerce between the two vigorous young commonwealths of the West

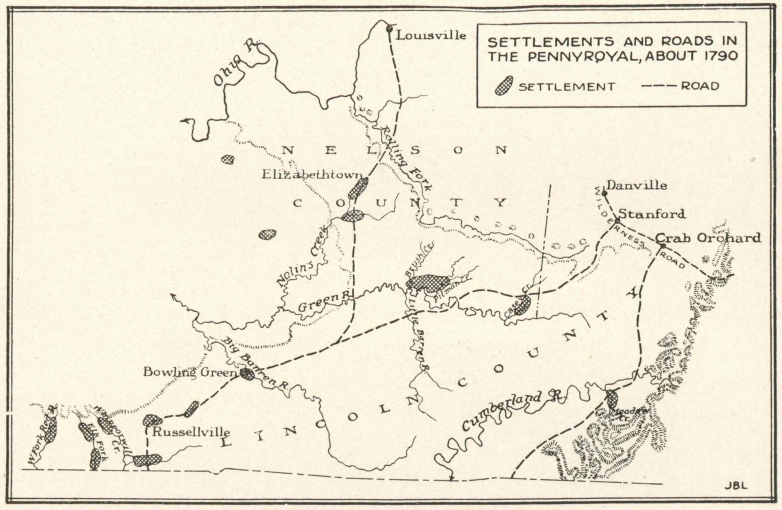


FIG. 74. MAP SHOWING SETTLEMENTS AND ROADS IN THE PENNYROYAL, ABOUT 1790.

passed through the grassy plains of the Pennyroyal, which was subject, therefore, to reconnaissance by the settlers of both neighboring regions. Figure 74 attempts a reconstruction of the early lines of communication through the Pennyroyal.

The soil was not dissimilar in appearance to that of the Nashville and Bluegrass areas in depth, texture, color, and derivation from limestone. Limestone land was in good repute. In its central part the area is more nearly level than are any parts of the Bluegrass or Nashville regions. The outstanding difference was the lack of trees. Here was to some extent a perplexity as to settlement, but also an engaging opportunity in frontier economy. For was not the land in Filson's words "cover'd with excellent grass and herbage," with livestock the most marketable product of the western frontier?

The first settlements (see Figure 74) were all in the timber or on its edge, not necessarily because of any distrust of the fer-

tility of the grass-lands, but because a site in the forest country was more eligible for the frontiersman. For example, the oldest settlement in Wayne County, before 1790, was made on Meadow Creek, at the base of the Mountains and in a cove extending back into the mountians. Here was good timber for the home and the farm needs, walnut and chestnut that split easily into rails and could be hewn readily into timber, the soft, strong yellow poplar, a wood of all uses, and giant white oak to be riven into shingles. Here were also great, cold springs issuing at the base of the Mountains, stone for fire places and chimneys, and abundant mast for hogs. Immediately adjacent were the meadows of the limestone plateau and level, deep soil that could be cultivated without clearing. From this obvious vantage point settlement spread along the Mountain Margin, a similar nucleus developing on Fishing Creek about 1800. The former became the county of Wayne, the latter Pulaski.

The situation appears to have been typical for the entire region. Ease of ingress from the Bluegrass or from Nashville, accessibility to water, timber, and grass appear to have fixed the first settlements along the line of contact of grass and timber country. The oldest marks of pioneer culture, log cabins of great hewn blocks of walnut or yellow poplar, ancient orchards and the like are to be sought—and still to be found—in the decadent "glade" country, where timber and grass met.

At the north the Elizabethtown settlement dates from about 1780. Here an old trace from the Falls of the Ohio ascended Muldraugh's Hill, main escarpment of the Knobs, and then dropped to the pleasant valley and springs of Souvren's Creek, now called Valley Creek, near which Elizabethtown lies. This is almost at the very northern edge of the limestone plateau and of the grass lands. It was the first eligible site for frontiersmen coming from the north. Out of this settlement grew Hardin County. At the crossing of the next valley to the south, Nolin Creek, another settlement formed, Hodgen's Mill, later becoming Hodgenville, and the expanded settlement formed Larue County.

Both of these groups, that of the Mountain Margin and that of the Elizabethtown Area, were settled from the Bluegrass and

Ohio River. A third avenue into the region from the Bluegrass was by way of the shale gap at the head of Green River. Trial settlements pushed out from Stanford about 1780. There was a settlement in the broad shale basin of Casey's Creek, a short distance up from its mouth, another on Pitman's Creek, a third on Brush Creek, and. between, an early ridgetop colony, at Summersville. These soon developed a central nucleus at the crossing of the Green River, where Greensburg was founded. In this section the prairies consisted of narrow strips on the ridges. The country along the Green was well wooded. The settlements were placed at some distance from the main valley on readily tilled creek bottoms, within convenient reach of the uplands. The route from Danville and Stanford to Nashville was much used in the early days, though it is almost disused now. Superior early accessibility appears to have favored the early growth of these communities, Green County having the largest population of any Pennyroyal county until after 1800.

The penetration from the Nashville Basin was equally vigorous, but more concentrated in approach. Its center was in Logan County, where the Three Forks of the Red River, and also Elk Fork, West Fork, and Whippoorwill Creek provided desirable sites along the base of the Clifty escarpment. The headwaters of Gasper and Muddy rivers, rising in solution basins on the limestone upland, but flowing northward, furnished additional sites in this greatest cluster of pioneer communities. The settlement at a big spring on the last-named stream was most centrally located with reference to the other settlements. Here was located the town of Russellville, long the largest place in the Pennyroyal, having 532 inhabitants and numerous attractions of town life in 1810. At this point the road turned south to Nashville, a cross road connecting with the settlements to the west, that later split off to form Christian County. Thirty-two miles to the northeast of the Three Forks of the Red River, according to liberal pioneer road measurement, lay the crossing of the Barren, a place usually involving ferrying. Here Bowling Green was located and about it Warren County formed.

From these earliest centers, each representing the most desirable locality for pioneer conditions and superior access either

to the Bluegrass or Nashville Basin, the settlement of almost the entire area may be derived by continued expansion, first along the forest fringe, either valley or escarpment margin, then out into the barrens. Logan, Hardin, and Green were the original counties established in the Pennyroyal, all of them in 1792. Their county seats still are the original towns of Russellville, Elizabethtown, and Greensburg. At first these counties had attached to them not only almost all the Pennyroyal but also the wilderness country of the Western Coal Basin. At the east their boundaries followed in large part a line located in the Knobs and indicated the emergence of the Pennyroyal as a group of communities distinct from the Bluegrass.

Christian County and Warren County were established in 1796, by fission from Logan County. The Pennyroyal Plain thus early achieved dominance through more rapid growth, having three counties as against one for the Elizabethtown and one for the Greensburg Area. The distant Mountain Margin received recognition by the organization of the County of Pulaski in 1798. In the same year the western extremity had gained enough importance to become Livingston County, as did the Cumberland Valley, from which Cumberland County was created. Thus, prior to the end of the Eighteenth Century, the physical articulation of the area found expression in distinct centers of settlement sufficient to warrant separate political organization.

Pioneer Economy

Apart from the essential of self-sufficiency that was imposed on every early American frontier, the economy of the frontiersman showed considerable diversity according to place and time. Cultural succession is not uniform; the hunter, followed by the stock-raiser, who in turn gave way to the farmer in general, is a myth. Locally the first settlers were farmers, who became increasingly interested in grazing, until pressure of population caused a partial replacement of livestock by other interests. The Pennyroyal was the first area in the country in which grazing developed on a large scale.

The free range of the wild grass-lands was stocked with cattle and horses. The timbered slopes gave range for hogs. For

the first decades of the Nineteenth Century we have no census of production. It appears that the maximum period of cattle raising was before 1830. The number of hogs continued to increase until the Civil War. Grass grew best in the best areas of the Pennyroyal; the cattle range was plowed up as soon as large-scale cultivation drew the farmers away from the valley margins. Mast, however, became more, rather than less abundant, with the spread of forest vegetation. Winter grazing was sufficiently good so that almost no hay was put up. A small surplus of corn above the household needs was fed to stock. Cattle were driven to markets south or east; horses and mules were sold to the cotton plantations; hogs were sometimes driven to the cotton country, but more commonly marketed by boat as salt meat. "In 1828 the value of the cattle, horses and swine driven out of the state, numbered and valued at one point of passage, the Cumberland ford, was a million dollars."[1]

The settlers came from tobacco-growing districts on the sea-board. Tobacco was the ordinary cash crop of the frontier, planted on virgin leaf-mould in forest "deadenings." The earliest local tobacco farming was in such deadenings. The timbered hills of the upper Green Valley, now in considerable part "thrown away" as farming land and grown up again in timber, and the forested Cumberland Valley, represented the most important early tobacco growing districts. The traditional cultivation of tobacco on new forest ground probably had a good deal to do with the large importance of the forested upper Green basin in the earliest period. The crop was not grown on one piece of land sufficiently long to cause the farmer the regard permanent fertility or proneness to erosion seriously in the selection of land. Tradition had it that the best ground for tobacco was "in the poplar timbered lands, where it is a deep, ash colored mould, rich, durable, and capable of producing an hundred bushels of corn an acre." The same account continues: "The inhabitants make use of this soil for the culture of tobacco, of which they raised great quantities last season (1816). I scarcely passed a plantation (in the Cumberland Valley) which had not a tobacco field; for which purpose they had uniformly cleared

[1] Davenport, Gazetteer, p. 130.

a piece of new ground. The country merchants were offering from twelve to fifteen dollars a hundred in advance."[2] All of this was usual procedure.

Perhaps we may generalize the earliest farm scene as involving cattle grazing on the plains, hogs foraging in the woods, a tobacco patch in a new forest clearing, and cornfields on the older clearings. Gradually it was discovered that tobacco did just as well on prairie land, and that it could be grown on such land not for a year or two, as in the forest, but as part of a permanent farming system. How or when this discovery was made is not known, but it revolutionized the local agriculture between 1830 and 1860. It gave final dominance to the Pennyroyal Plain among the divisions of the Pennyroyal and made it one of the greatest tobacco growing regions in the world.

The Pioneer Stock

The valuation placed upon this region a century and a quarter ago was, we may imagine, no less than for other superior sections of the West. The ambitious frontiersman had as good reason to locate in the Pennyroyal as to turn to any tract of land then available, excepting only the Bluegrass, whose superiority to all other land in the West was never questioned until the settlemen of the Illinois prairies.

There appears therefore to be no important departure in stock from the other regions of Kentucky and Tennessee. Revolutionary ancestry is so common that a political orator referred to his audiences in a town of the Mountain Margin as "sons and daughters of the American Revolution" without undue rhetorical license. The land between the Green and Cumberland rivers was opened to military claimants under the laws of Virginia subsequent to 1783.[3]

In the Cumberland river counties and the Pennyroyal Plain the older families are largely connected with the Nashville Basin. These southern counties have abundant reminders in family names and traditions of the time when they were the northern fringe of the "Settlements of the Cumberland." From the Barren River northward the immediate source of the population

[2] Brown, J. R., Gazetteer, p. 84.
[3] Perkins, J. H., Annals of the West (1846), p. 266.

is somewhat more diverse. Here one finds not only family connections with the Bluegrass of Lexington and the Beargrass of Louisville, but families which came directly from Virginia, Pennsylvania, and even New York by way of the Ohio River. In the Tennessee border the Scotch-Irish element is perhaps a little stronger than farther north, where Pennsylvania German, Huguenot, and Dutch ancestry is common. In general the racial distribution is that of the trans-Appalachian South, with a predominance of English ancestry.

The phonetic spelling of the poorly literate frontier has worked havoc with the genealogic evidence of many Kentucky families. Their own tradition is often obscure as to whence their ancestry came overseas. A minority of the names are still definitely recognizable as to origin. In Larue County for example one encounters such names as Chaudoin, also spelled Shaddoan elsewhere, Despain, Desarn, Duien, Lafolette, Larue, Pluvier, Poteet, Trombo, which are almost certainly French. German names are even more abundant in the county and some of these families are numerously represented. Here belong such names as Huber, Corinth, Shoffner, Salsman, Slach, Russman, Beeler, Holtzhouser, Kesler, Sowers, Jaggers, Wirth, Hornbach, Carrico (Kircher), Sifers, Cofer, Ballenger, Deitchman, Snyder, Castor, Everhart. Irish names are more numerous than Scotch-Irish in this area and include such families as Mahoney, Dunn, Obannon, O'Daniel, Daugherty, Dever, Hagan, Murphrey, Sullivan, Toole, and Kelley, their religious affiliation long since transferred in the main to the Methodist, Christian, and Baptist creeds. These names therefore are but blurred reminders of the days when the people were of different nationalities. The population is now equally homegenious in physical traits, faith, and language.

Regarding the capacities of the people who made their homes in this region we have further emphatic evidence. Both Abraham Lincoln and Jefferson Davis were born in the Pennyroyal, the former in the Hodgen's Mill settlement of Larue County, the latter in the more aristocratic vicinity of Russellville, which at a later date was the Confederate "capital" of Kentucky. It was natural that when the Lincoln family left its home in the Ohio

River margin, to join the drift to still newer lands, it should have turned toward Indiana and Illinois, as many other North Kentuckians did. The Davis family, belonging to the planter class, heard of the greater prosperity to be gained through cotton growing, and turned to the new lands of Mississippi. These first settlers were restless land prospectors and in many cases it required less than dissatisfaction with their homes to induce them to try their fortune farther out on the frontier.

The old Hardin County area, in which lay the boyhood home of Lincoln, was the home of the noted Helm family, which produced one of the most notable governors of the state and furnished a brilliant group of sons and daughters to the South. Here lived for a time John James Audubon and his business partner, General Duff Green, of President Jackson's "Kitchen Cabinet," as well as for a period James Buchanan, later President of the United States. The community in which Lincoln grew up, was neither backward nor poverty stricken as pictured in popular biographies. It was, on the contrary, a vigorous frontier settlement in which moved men of vision and ability.[4]

Regarding the other most important early nucleus of settlement, Logan County, Collins cites the following local statement from the middle of the past century: "Four times the gubernatorial wreath of Kentucky has crowned the statues of her fame—John Breathitt, James T. Morehead, John J. Crittenden, and Charles S. Morehead. Four times the spotless mantle of the chief justice of the commonwealth has fallen upon the shoulders of those who were members of her bar—Ninian Edwards, George M. Bibb, Ephram M. Ewing, and Elijah Hise. Three times the laurels of the foreign ministry of the nation have been worn with honor by those who were her citizens—Anthony Butler, Ninian Edwards, and Elijah Hise. Five times the chief executive chairs of other states have been filled by those who went forth from her midst—Ninian Edwards and John McLean to Illinois, Richard K. Call to Florida, Robert Crittenden to Arkansas, and Fletcher Stockdale to Texas; besides these, Wm. L. D. Ewing

[4] Collins (p. 311), attributes the following statement to President Buchanan: "He told Mr. Hardin that he went to Kentucky, expecting to be a great man there, but every lawyer he came in contact with was his equal, and half of them his superiors; and so he gave it up."

was lieutenant governor of Illinois. She has sent forth one major general of the United States army, James Boyle, and one surgeon general of the same, Dr. D. McReynolds; and one supreme judge of Mississippi, Joseph E. Davis." Surely this was no mean performance for two generations of one county, containing one town, and that of about a thousand inhabitants.

It is neither correct to assume that the area in its first period was less attractive to settlers because of a supposed odium attaching to its name of Barrens, nor to believe that it has suffered in any unusual degree by the migration of its pioneer stock. The blood of these pioneers is still the dominant blood of the area.

CHAPTER NINE

RURAL CULTURAL PATTERNS

Man as Geographic Agent

Man has changed this region in various ways from its original condition. One group of modifications for which man is responsible dissemble his works because the effects are similar to those of ordinary physical agencies. It is only through an intimate knowledge of the ground that we become aware of the extent to which the hand of man is expressed in the wood-lots that now dot the former prairie surface, in the numerous ponds that are clogged sinks, in the gullied slopes that are old fields. These are in the main involuntary effects of human occupation.

Man is also a geographic agent in the superposition of his works upon the natural scene, consciously and in his own manner. He thus makes his cultural landscape, which is the most important geographic fact of any occupied area. By making the landscape express his use thereof man becomes the latest of the geographic agencies. The cultural appearance of a landscape changes with time. There are young, mature, and aged cultural landscapes, as there are similar cyclic features in the physical land. We may therefore speak of the cultural morphology of an area as well as of its physical or geo-morphology. The aim of the following chapter is to set forth the cultural patterns of the Pennyroyal in terms of site, of activity of the people, and of time.

Farm Land and Other Land

The Pennyroyal is not only essentially a rural, but almost entirely an agricultural region, a region of farms with villages at intervals, and here and there a town. In 1920 Kentucky had 84 per cent of its land surface in farms; the Pennyroyal, 87. There was relatively more farm land in the Pennyroyal than in Kansas and only slightly less than in Illinois. This relative extent of farm area does not indicate for the Pennyroyal agricultural quality comparable to these two great farming states. It means rather (1) the slight diversion of land to other than agri-

cultural uses, (2) a physical build of landscape of such character that non-arable lands are not segregated in large blocks from agricultural land, but are intimately intermingled with plow lands and hence belong to farms, and (3) an advanced stage of agricultural occupation, in which demand exists for virtually all potentially arable land. Similar conditions hold for Kentucky as a whole.

The non-arable lands of the region are mostly hillsides, in smaller measure, upland swamps. Both land forms are intimately associated with arable surfaces. The ownership of the arable land has therefore involved for the most part acquisition of title to the rest of the land. Lumbering and mining did not result in large land holdings in Kentucky because of the early settlement of the state. Even in the Mountain sections, such industrial holdings have been formed largely by the laborious consolidation of small farm holdings. In the Pennyroyal there were no extensive timber tracts left when lumbering became a large-scale business. Virtually from the beginning the land of the Pennyroyal has been in the hands of the resident population, yeomen or planters, in tracts commensurate with their argicultural economy.

By estimate, not to exceed three per cent of the land surface is occupied by towns, villages, private rights of way, and homesteads of less than farm size. By the definition of the Bureau of the Census, homesteads containing less than three acres used for agricultural purposes are excluded from the category of farms. These very small rural properties, a sort of American equivalent for the British "crofts," are unusually numerous in this region, as they are in sections of Virginia and Maryland. Along the major highways or "pikes" such places are very common, in some cases so much so that the highway has the appearance of an excessively elongated village street. Good roads are as yet not numerous in the Pennyroyal. An "all-weather" road therefore is of large social significance. People retire from their larger farms to a small place along the "pike" where they can have a garden, some chickens, and a cow, and where they can watch the principal part of their world go by. Others open shops such as the community can support, or work on public jobs

and at other odd labor, in each case growing a large part of their kitchen supplies on a small tract of ground located on the high-

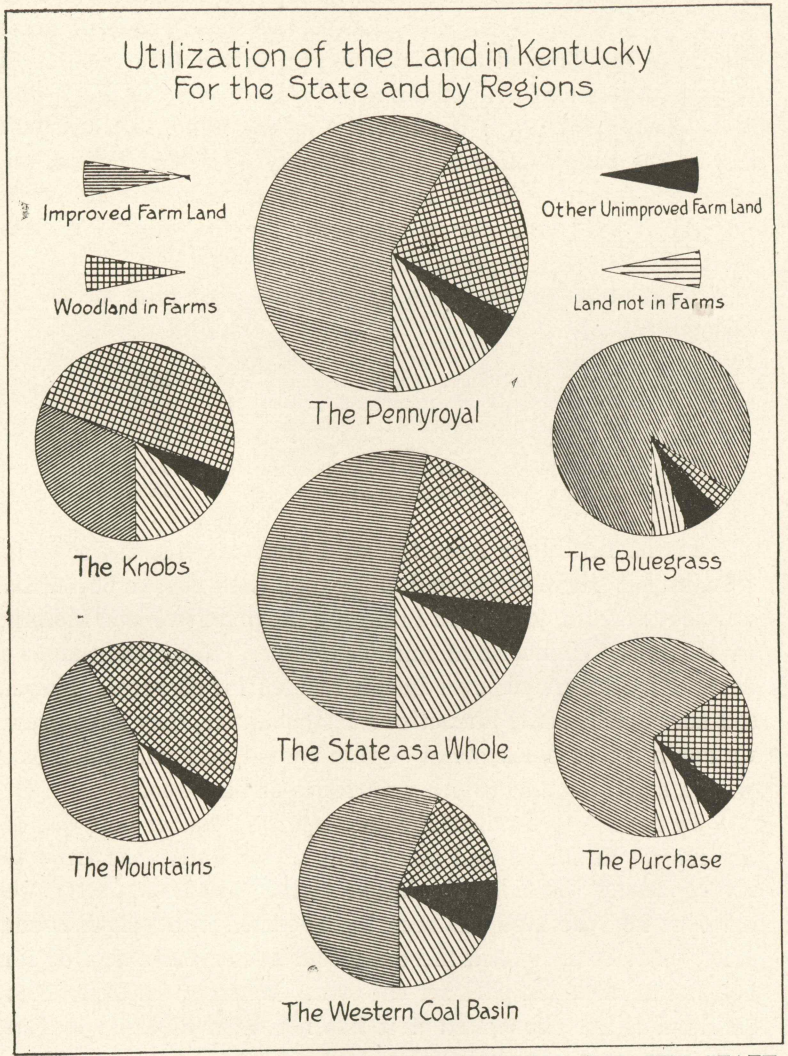


FIG. 75. UTILIZATION OF LAND IN KENTUCKY, FOR THE STATE AND BY REGIONS

way. Farther north, where winter enhances the attractions of a compact community, such people move to "town." The Kentuckian moves to the "pike" and thus escapes the principal hardship of winter, the isolation imposed by mud.

There remain unaccounted for about ten out of every hundred acres of land surface in the Pennyroyal. These are mostly timber lands that have not been incorporated into farm area. They are largely concentrated in the two most dissected areas, that is in the Cumberland Enclave and in the Interfluve Area. Of 650,000 acres of wild land not in farms, located in the Pennyroyal, nearly half is in the counties of the middle Cumberland and in the rough lands of Allen County adjacent thereto, and about one-fourth is in the Interfluve Area. An estimate of the amount of wild land not in farms for the six counties of least farm development is given below:

Wild land, not in farms, in percentage of total surface of each:

Lyon (Interfluve Area)	28%
Cumberland (Cumberland Enclave)	25%
Monroe (Cumberland Enclave)	25%
Livingston (Interfluve Area)	25%
Russell (Cumberland Enclave)	22%
Allen (Greensburg Area)	18%

In the Interfluve Area the wild lands include the so-called "Coalings," ridge slopes and ridge tops (See Figure 55), which were cut over for cord-wood to supply the primitive iron industry of the lower Cumberland and Tennessee. Many thousands of acres of land were cut over in this fashion for charcoal. Neither soil nor surface being attractive for agriculture, they have grown up again into a dense stand of thin-bodied post and black oaks, with a small amount of other varieties of hardwoods.

In the upper Cumberland country the "timber boundaries" are mostly in the rugged creek hills at some distance from the river. Along the river the larger timber has been pretty well cut over and the land has been incorporated into "farm boundaries," but farther back there are still good-sized tracts of timber, not in farms, in part not cut over. Whether cut over or not, the land is not devastated if it has not been diverted to farm uses. The only exceptions are to be found in cut-over stands of cedar, which furnish sufficiently inflammable material for serious burning. The hardwood tracts after logging grow up rapidly again to forest. In the Cumberland country, logging has been restricted to the removal of large timber of valuable

species. In contrast to the Interfluve Area therefore the second-growth stand is not excessively increased in density. Occasionally one may still see several hundred acres of virgin timber in one body. This is particularly true of beech, which was until recently not in commercial demand.

At the opposite extreme are the counties of the Pennyroyal Plain. Here, and even in some parts of the Clifty uplands farm, town, and croft communities account for virtually the whole land area. In Simpson County the census gives the percentage of total land area in farms as 105.*

Simpson is a county almost without bodies of land outside of farm communities. Todd County, also in the Pennyroyal Plain, is credited with 96.1% of its land in farms. Caldwell County, largely in the Clifty upland, has 98.5 per cent of its land surface in farms. Here the smooth uplands of the sandstone plateau and the limestone basins and perched flats of the fault-block topography adjacent are of such a pattern that farm ownership has been extended over virtually all of the land, though the amount of cultivated land is high neither in the aggregate nor in the individual farm.

Improved Farm Land and Size of Farms

About 59 per cent of the total land area of the Pennyroyal is improved farm land. About 28 per cent of the land surface, the remainder of the farm area, is in wood lots and miscellaneous farm land. The miscellaneous farm land consists largely of cleared land that has gone out of cultivation and constitutes now a large part of the poorer pasture land of the area. The distribution of improved land with reference to total land surface and other land uses is shown in Figure 75 for the state as a whole and for its natural regions. It is evident that the Pennyroyal approaches most nearly to the average of the state. In

* The impossible figure simply illustrates the difficulties of statistical work locally. It is impossible to check up on areal data in the absence of a general land survey. The boundaries of many "descriptions" overlap, especially in their uncultivated portions. The size of property is often a matter of guess rather than of survey. County boundaries in places are not known definitely. Some farms lie across county boundaries, but may be reported to the census and even to the tax collector as though they were in the one county. The majority of counties have no surveyor's plat and tax and census rolls are therefore likely to be made with numerous errors of omission and some of duplication.

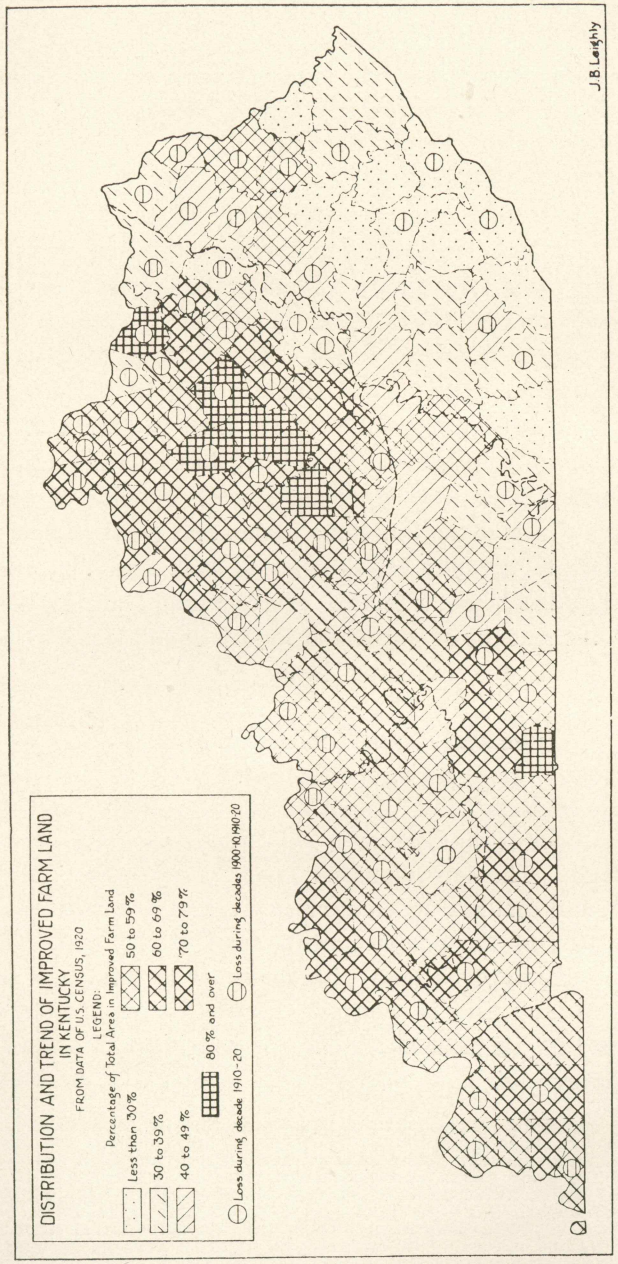


FIG. 76. DISTRIBUTION AND TREND OF IMPROVED LAND IN KENTUCKY.

improved land surface it is slightly above the average of the state, standing about midway between the Knobs and the Mountains on the one hand and the Bluegrass on the other. A similar condition exists for the woodland in farms.

Distribution of improved farm land by counties is shown in Figure 76. The resemblance is manifest in this respect of the Mountain Margin and of most of the Greensburg Area to the Mountains. It is not possible to argue from low percentage of improved land to a low agricultural level. Cumberland County, which is lowest in the Pennyroyal in percentage of improved land surface, is in general a county of productive river and creek-bottom farms, higher in economic level than the fault-block country where a much higher percentage of land surface is improved. The plow land in the eastern counties is simply much more definitely segregated, topographically, than elsewhere. A notable fact conveyed by this figure is that almost half of the counties of the Pennyroyal increased their improved land during the last census decade, the most notable exception being the Elizabethtown Area. In this respect the Pennyroyal as a whole resembles the Mountains and is in contrast to the Bluegrass.

Few sections of the United States of similar quality of land show a similarly high percentage of land improved and as largely an upward trend to date as does the Pennyroyal. The people have continued to adhere to the soil in unusal measure, as was indicated also by the figures of population growth (Figure 73). Northern factory towns and the newer western farming communities, until lately, have not exercised as strong a pull upon the local population as might be expected. As folk have become more numerous they have made more farms, in part by additional clearing, in part by living on smaller farms. Only recently, and especially on the Ohio River margin, has a definite cessation of farm extension made itself manifest. The explanation for this continuation of farm extension must be sought in a condition of contentment of the people with their home which is sentimental rather than economic. The recently added farm lands are not of superior quality, nor has there been a change in the economic system which has made it more profitable for them to apply their labors to a smaller acreage.

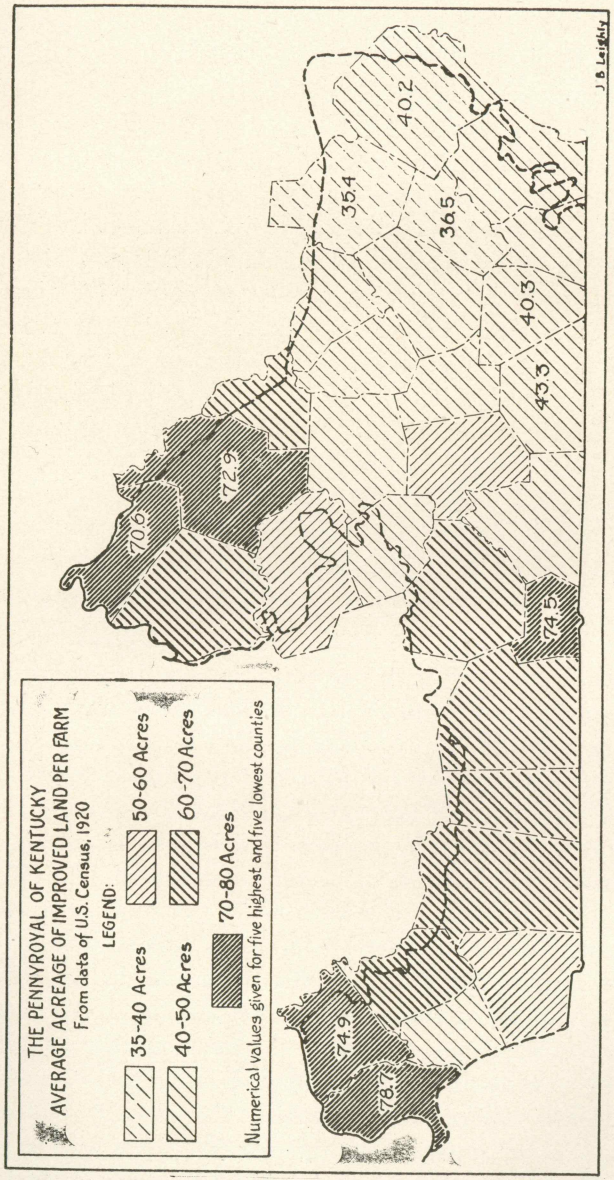


FIG. 77. AVERAGE ACREAGE OF IMPROVED LAND PER FARM.

For the Pennyroyal as a whole the average size of farms is 84 acres, as against 80 acres for the state. The improved land per farm is about 56 acres, as against 51.6 acres for the state.[1]

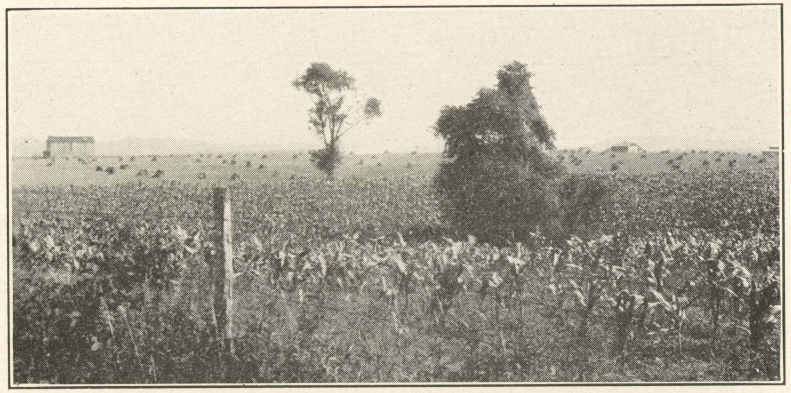


FIG. 78. NORMAL FARM SCENE IN PENNYROYAL PLAIN.
This view is in northern Barren County. The barn at the left is used for tobacco. The barns are usually high and closely sheathed, narrow strips being nailed over the wider boards to prevent escape of the heat from the fires are kept burning during the curing process. As usual, corn and wheat predominate in the scene.

Within the Pennyroyal there are large contrasts sectionally in farm size, as shown by Figure 77. The average farmer of the eastern counties has the smallest amount of land to work. Casey County, partly in the Knobs, is at the foot of the list, with only 35.4 acres of improved land per farm. At the other extreme are the counties of the western margin, with more than twice as much land available per farm. The high-class counties of the Pennyroyal Plain have improved acreage per farm above the average of the region. The counties at the extremes offer little to choose between them as to quality of land. The difference is one rather of mobility. Thus Casey County gained about 11 per cent in population between 1910 and 1920, more than 7 per cent in number of farmers, and 6 per cent in improved land. The lower river counties on the other hand show losses in population and in general losses in improved land. The people in the eastern districts of the Pennyroyal live in a section which has few communications with the world outside. They stay at

[1] Figures for the Pennyroyal adjusted to include fractional portions of marginal counties.

home, and multiply, their farms grow smaller, and they are still clearing land under pressure of their population needs. Those at the north of the Pennyroyal have felt the call of opportunity elsewhere, in the coal mining districts adjacent, in the towns

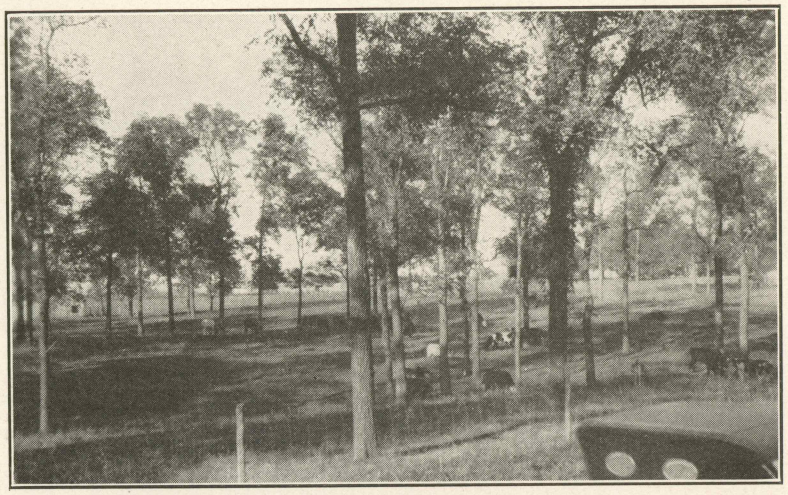


FIG. 79. A GROVE OF PARK PASTURE.

This view taken west of Cadiz is highly characteristic of the Pennyroyal Plain, the Bluegrass, and the Nashville Basin, as a component of the more aristocratic type of farm.

along the river and to the north, and of better land to be rented in Illinois and Missouri. Their farms in consequence are growing larger.

Area Under Crop

Improved land includes all land that may be plowed and in addition improved pasture and meadow land. Ordinarily the higher the ratio of land actually cropped to land improved the higher the quality of land. Thus ordinarily in such a state as Iowa crops are harvested annually from all but a small part of the improved land. On the other hand in the sandy area of the upper Lake States normally less than half of the land available for planting may have a crop harvested from it. In the Pennyroyal such a simple relation of area harvested and land quality is not evident.

The following ratios of harvested area to improved area obtained in 1920 for the various counties lying entirely within the limits of the Pennyroyal.[2]

Percentage of improved farm land in crop in 1920:

Russell	76	(Greensburg Area)
Christian	71	(Pennyroyal Plain)
Taylor	70	(Greensburg Area)
Clinton	66	(Mountain Margin)
Monroe	65	(Greensburg and Enclave)
Cumberland	60	(Enclave)
Green	60	(Greensburg Area)
Adair	57	(Greensburg Area)
Breckinridge	57	(Clifty)
Simpson	56	(Pennyroyal Plain)
Warren	56	(Pennyroyal Plain)
Allen	56	(Greensburg Area)
Metcalfe	55	(Greensburg Area)
Logan	55	(Pennyroyal Plain)
Barren	53	(Pennyroyal Plain)
Meade	52	(Elizabethtown Area)
Hart	52	(Elizabethtown Area)
Todd	50	(Pennyroyal Plain)
Livingston	46	(Marion and Interfluve)
Lyon	46	(Interfluve)
Trigg	44	(Interfluve and Pennyroyal Plain)
Crittenden	42	(Marion)

For the Pennyroyal as a whole only about 56 per cent of the improved land was cropped, a low figure as compared to states to the north. The large amount of uncropped land, which indeed is a striking feature in most parts of the area, indicates that more land has been improved than can find regular use in field crops, or in other words, that a goodly percentage of the land that has been improved has proved submarginal. Land in the Pennyroyal was improved usually only for one purpose, in order to have plow land. Now, scarcely more than half of such land is cultivated in any one year. In the northern states, large areas of land that have not been retained permanently under cultivation have become hay fields and thus still yield a regular harvest. Locally, hay does not seem to find a very suitable cli-

[2] A tabulation was made of the sum of all areas reported by the census as in specified crops. To this was added an estimate of area in orchards, using the arbitrary assumption of fifty trees to the acre. In some cases the same field may grow two crops in one season. A few minor crops are omitted in the census figures. The difference between the total, as thus derived, and the actual total crop area, is however not large nor is it important, since all counties were treated in the same manner. The relative extent of cropped and uncropped land as between the several counties is adequately expressed by the tabulation.

mate. Hay fields are therefore largely lacking in the agricultural landscape. Some of the improved land has dropped permanently out of the class of plow land and is used as pasturage, but often as pasturage in which blackberry briars, mullein, and tree

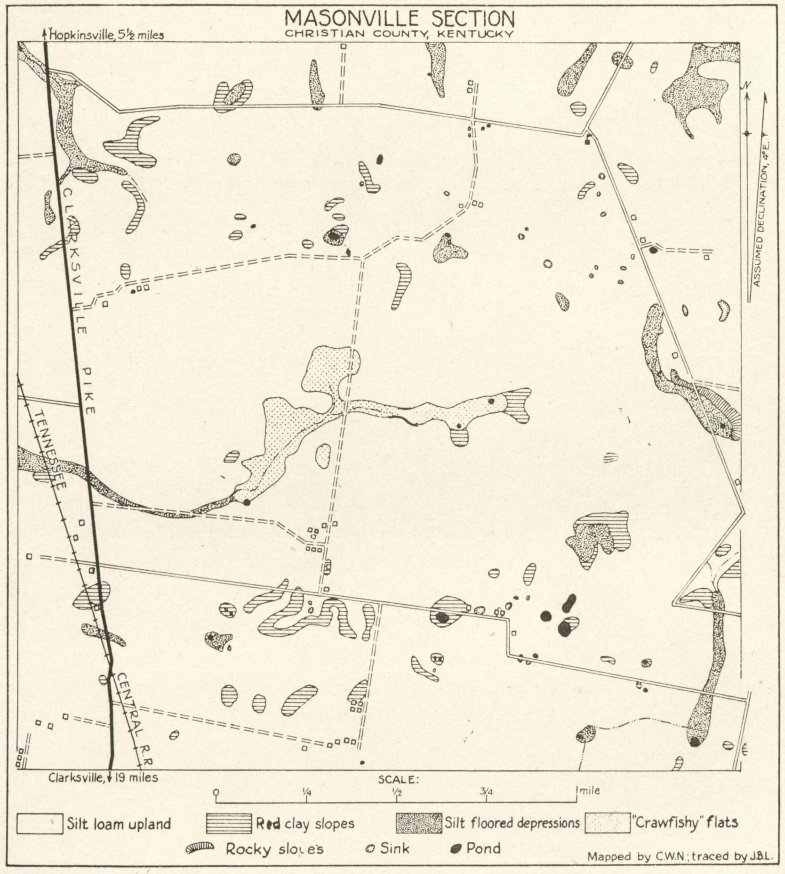


FIG. 80. MAP OF MASONVILLE SECTION, CHRISTIAN COUNTY, SHOWING CONDITION OF LAND SURFACE.

sprouts are more in evidence than grass. Much land is cropped occasionally, serving in ordinary years as pasture, or, having lain fallow for a time and accumulated a cover of weeds, brush, and grass, it is then "broken" again after such a rest and planted to crop for a year or for a few years.

The greatest areal contrasts shown by the table above are between the eastern and western sections. Russell County lies

in the dissected Greensburg Area, and is characterized by ridge and valley topography and soil derived from shaly limestones. It is second-lowest among Pennyroyal counties in improved land per farm (Figure 77), and highest in the percentage of improved land that is cropped. Crittenden County is at the opposite extreme, lowest in percentage of improved land cropped and second highest in acres of improved land per farm. The high percentage of improved land that is regularly cropped in the Greenburg Area is a further indication of the pressure of population in this rural area. At the western margin on the other hand a shrinking rural population is able to restrict cultivation to the better lands, or to cultivate the less good land at intervals after fallowing.

The northern region of cavernous limestones, the Elizabethtown Area, has less of its arable land under cultivation than is true of the Pennyroyal Plain. The rank of these limestone counties is closely related to topography. Christian County, has probably the smoothest surface of any of the counties and is the most productive. It is the only county that ranks in this respect with the greatly inferior counties of the Greensburg Area, and the other eastern sections. The rolling topography of such northern counties as Hart and Meade enforces a more frequent fallowing as the most effective protection or check against erosion.

Unimproved Farm Land

The local distribution of wood lots and other wild land is primarily an expression of topography. Wayne County, which has a share both in the breaks of the Cumberland and in the Mountain escarpment and outliers, reports 62.5 acres of woodlot and other wild land for the average farm. Cumberland County, surrounded by rugged river hills, is a close second with 61 acres. The other counties that rank high in wild land in farms are adjacent to these, in the Interfluve Area, or along the Ohio River.

In the Pennyroyal Plain wood lots are small, the unimproved land in Simpson County being only 11.3 acres per farm, in Warren 17.7, and in Christian 19.8. The figures are comparable to northern Indiana and southern Michigan. These woodlands are in part on rough slopes or in swamps, in part

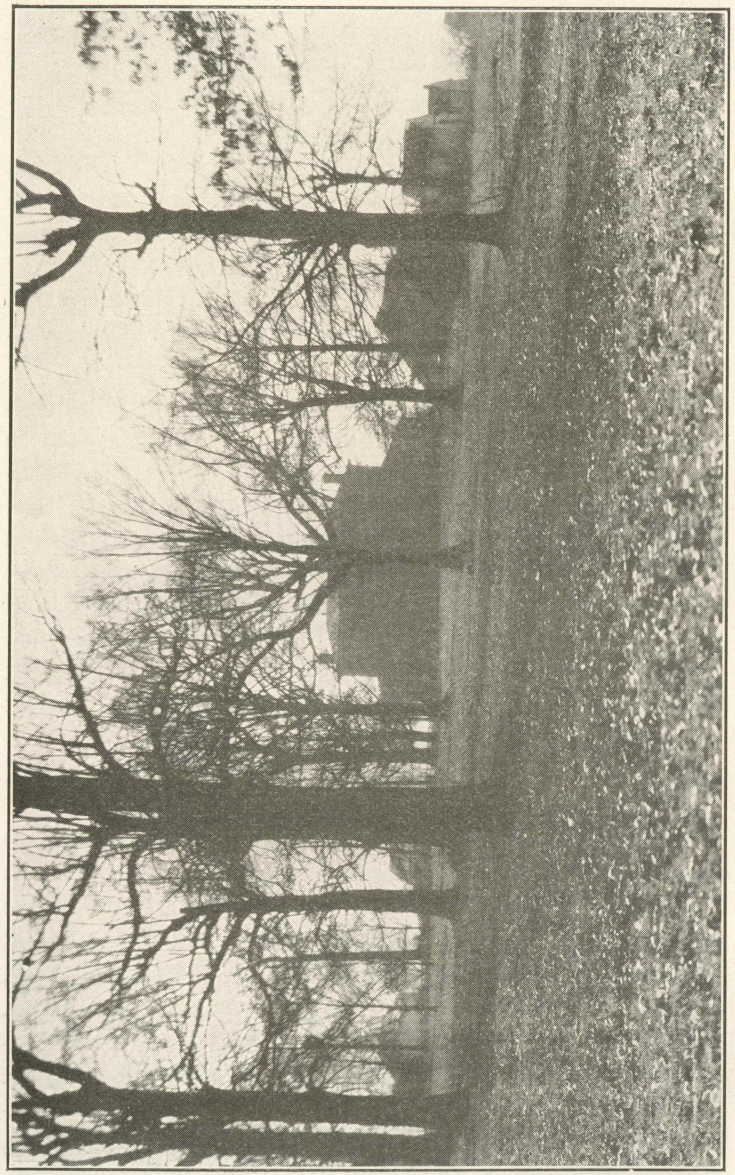


FIG. 81. BRICK PLANTATION HOUSE.
This house in the Masonville type section, set at the rear of a grove is flanked by negro cabins. The grove is really a park which serves as lawn and occasionally as pasture for horses. This setting is very similar to that of Bluegrass farms and probably was introduced from that area.

they express the farm need for a wood-lot or the desire to have a park.

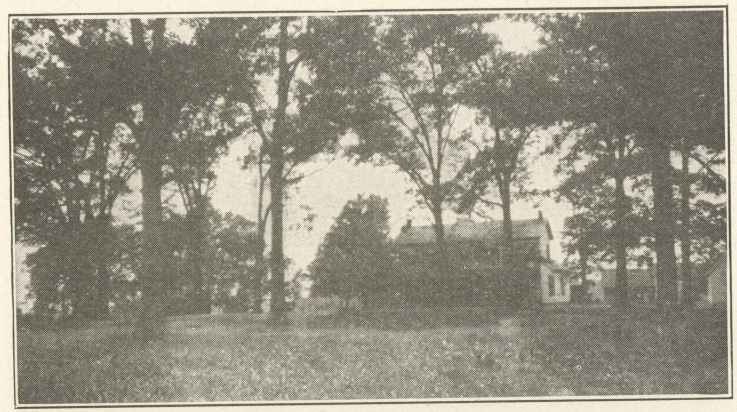


FIG. 82. FARM HOUSE NEAR HOPKINSVILLE.
This dwelling near Bolivar Church derives comfort in summer from its fine grove and two-story porch.

The Farm Landscape by Individual Areas

Pennyroyal Plain: Improved farm land occupies almost the whole of the rural landscape. The farm area is continuous and uninterrupted to the margins of the region, except for the country towns and the railways. The prospect across the region is not unlike that in the prairie states; within any horizon there are numerous, fairly evenly scattered farm homesteads in the midst of cultivated fields and smaller pastures (Figure 78). A planimeter measurement of 354 square miles of Christian County, lying within this area, using post route map and Bureau of Soils map, indicates 8.72 homestead per square mile on the normal brown loam lands of the cavernous limestones, as against 5.22 on the stonier clay loam of the more rolling margin, and 1.58 on the leached areas lands of the flatwoods. The first of these surfaces contained 308 of the 354 square miles measured; the areas of inferior density are minor, discontinuous tracts within the smooth brown loam lands, and strips of stony land against the Chester escarpment.

The area is reminiscent of the traditional south. Although the average size of farms is only about eighty acres, one may see in numerous localities groups of good-sized plantations with mansions set in parks and negro cabins clustered in the back-

ground. These larger farms are much in the manner of Bluegrass farms, spacious in every element of their design. Even paddocks are not wanting. Negro field laborers and negro tenant farmers are ubiquitous, comprising in some sections a third of the population. The number of tenant farms is large and increasing. In Christian County there are more tenant farms than farms operated directly by owners. The average size of the former is 43 acres in this county, of the latter, 124.

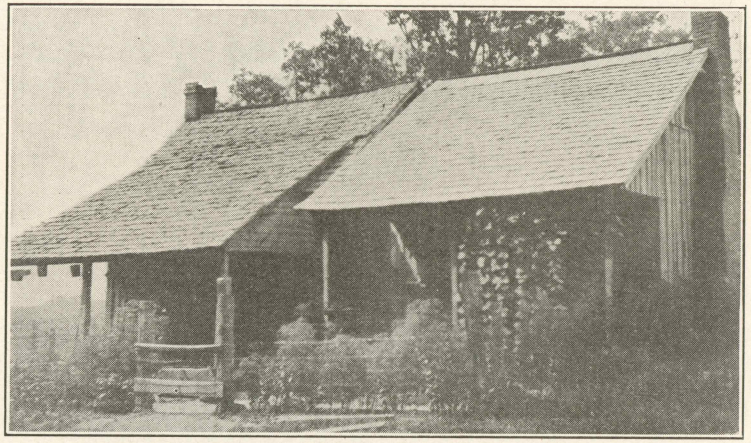


FIG. 83. NEGRO CABINS.
A pair of more than usually gregarious negro cabins, in the Masonville type section. Even here the porch has not been forgotten.

The cultural conditions of the Masonville type section are shown in Figure 80.[3] The layout of fields, woods, and roads makes a general rectangular cultural pattern, although there was no general land survey. Though much of the wet land is in woods and pasture, in many cases the woodlots are physically identical with the cleared lands adjacent. Much of the pasture land is left indefinitely in grass, as is the case in the Bluegrass, though the land may be well suited to plowing (see Figure 79). Such pastures are ordinarily conveniently close to the plantation house. Tobacco and cotton are planted on the well-drained lands. Corn may also be planted on wetter ground, but then is likely to make a large growth of leaf and stalk and is commonly cut green for ensilage or fodder.

[3] Compare this and subsequent type maps with the physical maps of the same areas.

In the Masonville section all the farms are large, several containing more than five hundred acres. In the past they were much larger, the area having been under large scale plantation production with the use of slave labor. Old brick farm houses

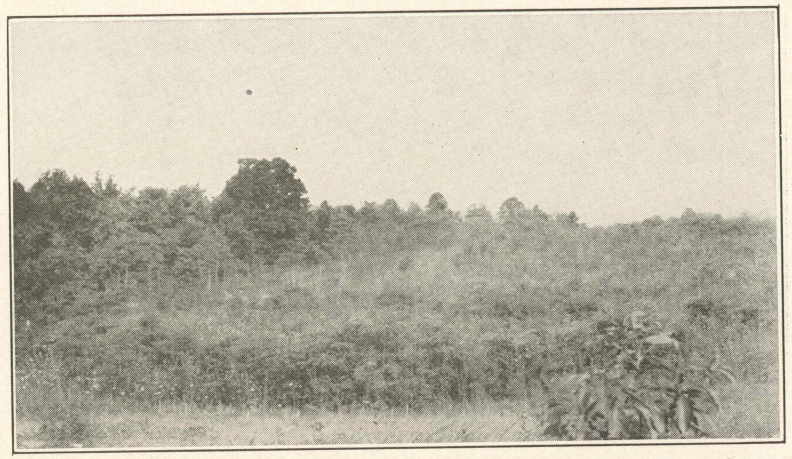


FIG. 85. OLD FIELD LINCOLN FARM.
This view shows a slope of worn land that has been covered by a young growth of sprouts, mostly sassafras. Across the fence is part of the same slope on which cultivation was abandoned some years earlier and which is now supporting a thrifty vounteer forest. The spread of forest takes place primarily from bushy fence rows.

(Figure 80), set in a spacious "grove," and flanked by negro cabins, are a common inheritance from ante-bellum days. Another house of the mansion type is shown in Figure 81, with characteristic ample verandas on both floors. Negro cabins are generally grouped near the plantation house or on a main road. Negroes generally refuse to become tenants on a farm unless there are other negro families there. A farm large enough to have only one negro tenant usually has none. This attitude may have an influence on size of farm operations.

In a normal year a typical farm has its acreage divided in about the following proportions: woodland 10 per cent, pasture 20 per cent, corn 30 per cent, wheat 20 per cent, tobacco 5 to 10 per cent. Tobacco is the chief cash crop, but lately cotton has been reintroduced with good success. All the tobacco and all the wheat are sold. Some corn may be sold, but commonly the whole

crop is fed on the place. Most farmers sell a goodly number of cattle and hogs each year.

Elizabethtown Area: Farm area is nearly continuous; farms average somewhat larger than in the Pennyroyal Plain,

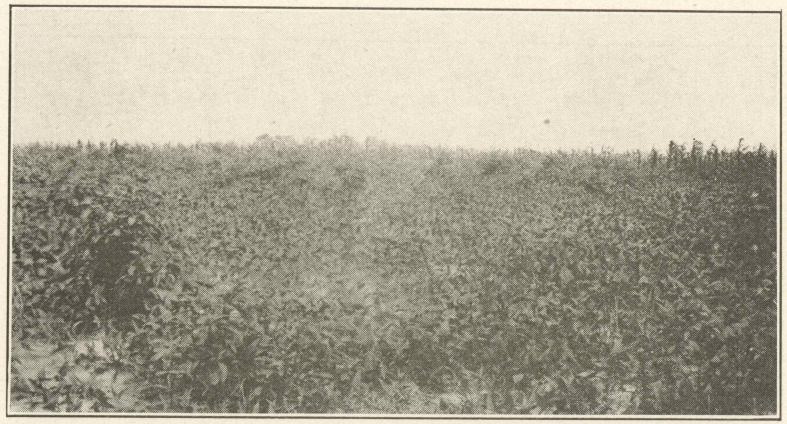


FIG. 86. FIELD ON LINCOLN FARM.
A slope similar to Fig. 85, which is recently brought under cultivation again and is producing a good crop of soy beans.

the usual size being a little above a hundred acres. The amount of improved land is nearly as great as to the south but the cultivated fields are smaller and more detached. Excepting only the river margins and swampy tracts, almost all of the land has been under cultivation. It was grassy and it did not lie too steeply for ready plowing. Almost the whole surface had the same sort of treatment, being planted largely to grain and tobacco. The rolling surfaces therefore began to wash after a time. Today the plowed land is in intricate adjustment to the lesser irregularities of topography. The smooth uplands are almost entirely under cultivation and appear to yield bountifully. A slight increase in relief, twenty to fifty feet, brings out upon the lightly rolling surface a decidedly patchy cultural pattern. The reddish slopes are cultivated occasionally or not at all. Normal crop land is found in the sink basins and on smooth upland remnants. The farmer therefore has his principal fields in scattered location about his farm and the limits of the fields, topographically prescribed, may be very irregular (see Figure 25). At present one sees in such a locality com-

monly not the whole of a fenced field under cultivation, but only the bottom or the top of the slope.

The Lincoln farm type section (Figure 84) shows to the west and southeast of the farm the major area of regularly

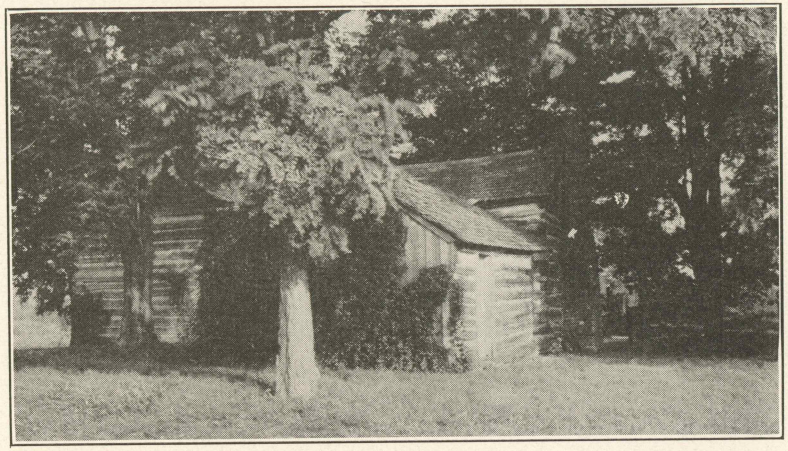


FIG. 87. CENTURY OLD LOG CABIN.
This cabin in the Lincoln Farm section is set in a small grove of black locust, commonly the first tree planted about farm homes, and still a great favorite in the Upper South.

cropped land, part of the primary solution upland. Here fields lie in blocks comparable to the Pennyroyal Plain in appearance (Figure 21). This good upland is however largely devoid of farmsteads, these, like the Lincoln homestead, being situated on the slopes of the adjacent solution basins, where springs and better drainage provided a more attractive building site.

In the rest of the Lincoln Farm Area the crop land is in patches, most of these patches being centered about a sink basin. A half dozen abandoned farm houses are scattered about the slopes of the large secondary solution surface, central to the section. The abandoned slopes are rapidly invaded by sprout growth, through which parts of the area are even now afforested (Figure 85). Latterly, hopeful results have been secured by reclaiming the slope lands through legumes. Cowpeas and soybeans often make a surprisingly good growth on land that has been "thrown away" (Figure 86). They cover the surface with a mat of vegetation which stops wash pretty effectively and,

used as green manure, they make the soil more absorbent of rain. It is however a slow and costly task thus to regain what the past generations of farmers have dissipated. The general trend of the rolling section is still downward.

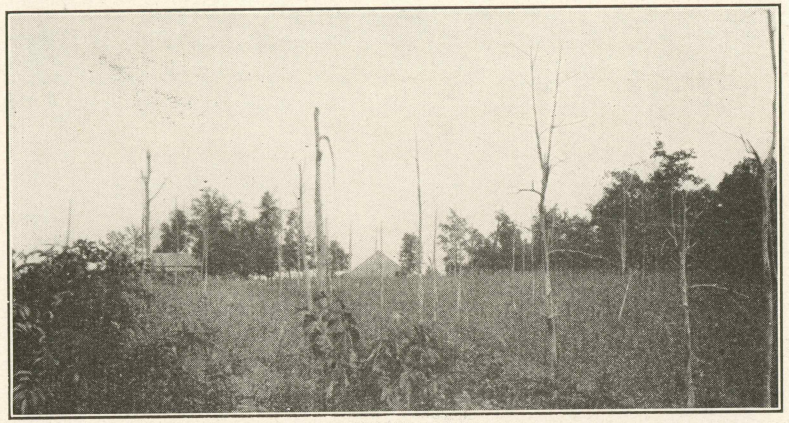


FIG. 87a. "DEADENING" NORTH OF CAMPBELLSVILLE.
Corn is the most characteristic stump crop of the area, though tobacco is still seen occasionally in such sites.

House forms tend to be like the more modest homes of the Pennyroyal Plain. Rather more numerously however, log cabins are encountreed (Figure 87). Timber was rarely remote in this area and the old homestead was not so commonly relocated and replaced by a more ambitious structure as in the counties to the south.

Greensburg Area: The wooded valleys break the area into communities, chiefly of four types, in so far as types can be isolated: 1, smooth districts on compact uplands beyond the limits of dissection; 2, ridgetop communities on ridge spurs; 3, cross-roads communities at the place of junction of several ridges, and 4, valley bottom communities. The last type is most divergent and in the northern breaks of the Cumberland is really part of the Enclave. The wooded valleys are for the most part the back lots of the farms, which front toward the ridge-crests.

The continuity of the ridges determines in major part their significance. The big roads are on the big ridges. Here frontage is most in demand. Large old farm houses along such roads have between them numbers of smaller, newer houses, indications

of the subdivision of holdings that has been going on. The newer places are especially numerous on the ridge spurs, near the valley margins. Here "deadenings" (Figure 87a) and stump fields are familiar sights, many of them descending perilously far down into the valley breaks. Log cabin and clapboarded dwellings, rail fences and wire fences, forms of different agricultural periods are largely intermingled in this area.

The smooth uplands, especially in Adair and Taylor counties, have rural communities of a condition of prosperity that compares not unfavorably with the second-best of the Pennyroyal Plain. Here are also a number of settlements made by farmers from states north of the Ohio, commonly identified by larger and better barns and more live stock than the other farms of the section. More commonly however in the Greensburg Area the farms are too small to support their population in reasonable comfort under existing conditions of farming. Many of the ridge communities have scarcely any marketable surplus aside from poultry and eggs, and in places, of tobacco. Their economic system rests upon extreme simplicity of wants and a very large measure of self-sufficiency.

The optimum conditions of the area are represented by Figure 88, immediately east of Campbellsville. In amount of regularly cropped land this section is second only to the Masonville type locality. Farms are large and prosperous, corn being the dominant crop, usually grown in rotation with clover and oats (Figure 89). Slope wash is negligible. Small bodies of woodland have been preserved, some of them on as good soil as is regularly cultivated. The farms are laid out in rectilinear patterns, the boundaries of the farms normally extending at right angles back from the principal pikes, ancient highways dating from the time of settlement. Buildings and outbuildings on the farms are commodious (Figure 90). Along the pikes are numerous small places of only a few acres, in considerable part comfortably equipped homes of retired farmers.

The Blackgnat section (Figure 91) illustrates the cultural pattern of a moderately large ridgetop community. This area was originally one of large plantations with exhaustive cultivation of the soil. Soil erosion became serious and widespread. In the post-war period the plantations were largely abandoned

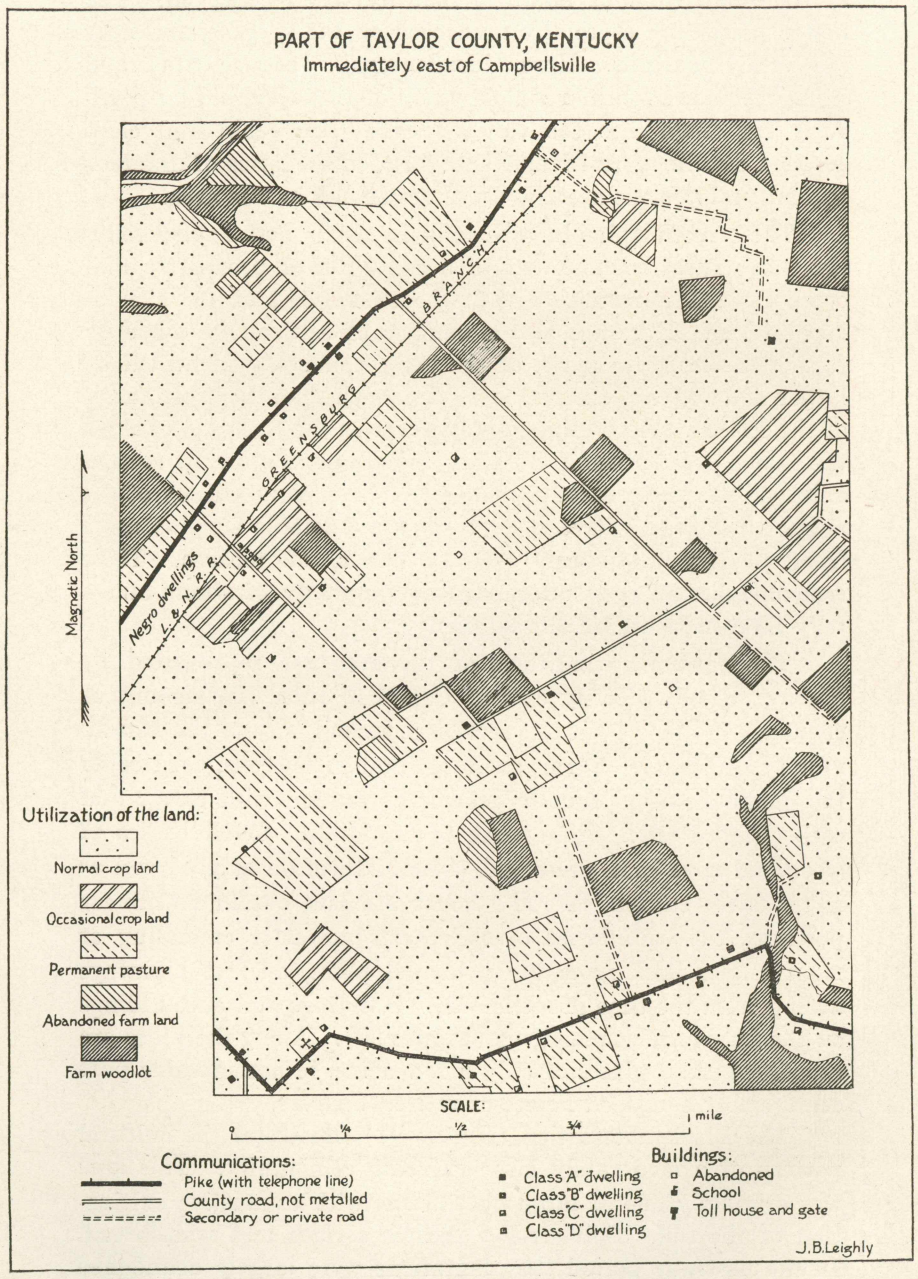


FIG. 88. UTILIZATION OF LAND IN PART OF TAYLOR COUNTY.

and gradually reoccupied by small farmers. Much of the early cultivated surface, especially of the tobacco fields, has however

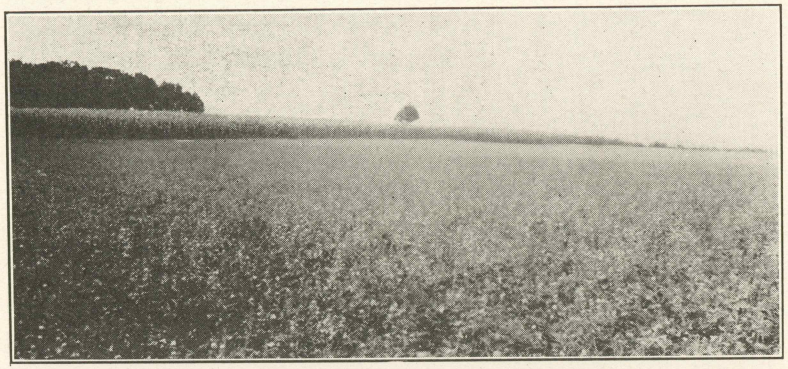


FIG. 89. PROSPEROUS FARM COUNTRY.

This view in the Campbellsville type section is on the smooth solution upland. The size of the fields is not unusual for this locality. Red clover in the foreground, a field of thriving corn in the background. Scene taken in early August.

not been brought back into cultivation permanently. A large plantation for example lay to the north of Pitman Creek, the house and cabins long since in ruins and the land all about abandoned and grown up in brush. The smooth upland remnants are being maintained under continuous cultivation. The slopes between the two upland surfaces and on the margins of the valleys hold ephemeral fields, some of them recleared, others

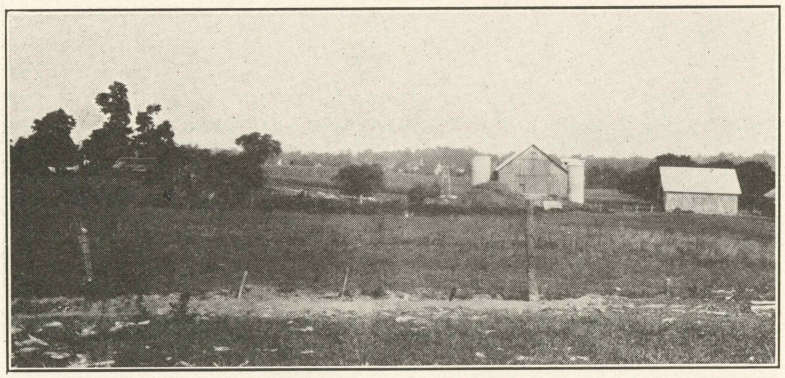


FIG. 90. HOMESTEAD IN THE CAMPBELLSVILLE TYPE SECTION.

The farm house is in the grove at left and outbuildings are situated down-slope toward valley margin. The silos are as yet somewhat unusual.

newly made from forest land. Figures 92 and 93 show contrast in productivity as related to difference in slope. The irregular

FIG. 92. A GOOD STAND OF CORN.

This view in the Blackgnat type section is on a remanent of smooth upland. View was taken in early August.

surfaces are not only deficient in plant food but they are especially subject to "burning out" of the thin soil in dry weather. A large percentage of the farms is grouped along the upland margins of the valleys, as shown by the houses on the pike leading east and west through Blackgnat. These farms mostly get their water from springs issuing a short distance below the upland level. The farms on the ridge to the north rely

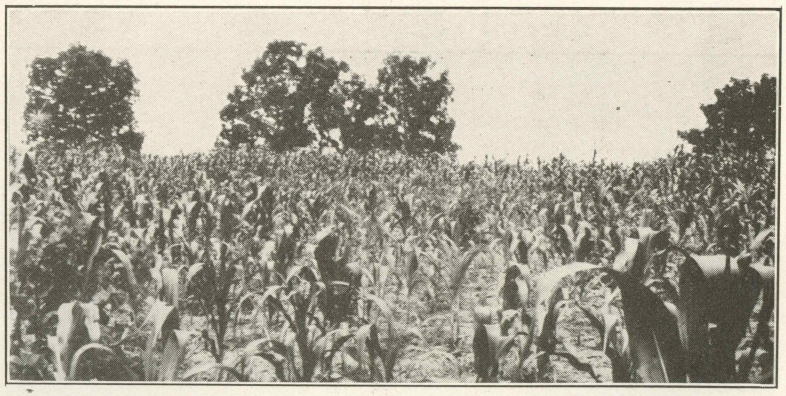


FIG. 93. CORN FIELD.

Part of the same planting as in Figure 92, in the Blackgnat section. It is located on a slope, gentle, but somewhat subject to slope wash. Corn produces a crop on such land ordinarily in moderately wet summers.

more largely on stock ponds made by throwing up an embankment of the heavy soil across a shallow draw, and on cisterns for household use. Ridges of this sort are commonly called "dry ridges." They were settled usually later than the valley margins, though they may antedate the most recent settlements that

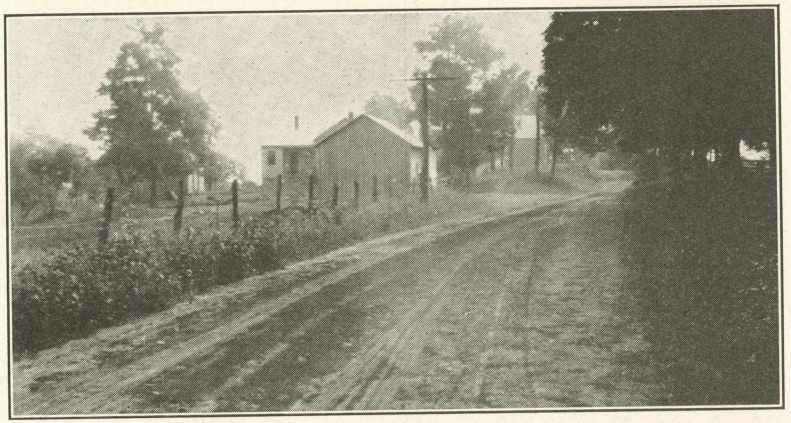


FIG. 94. FARM HOUSE ON RIDGE ROAD, BLACKGNAT.

have pushed out into the short ridge spurs and have established precarious farms on the upper valley breaks. A characteristic location and type of house on the ridgetop at Blackgnat is shown in Figure 94.

Marion Area: The large amount of cleared land is impressive, when one considers that level spaces are small and scattered, except in the limestone basins. The cropped fields are very irregular and scattered. The uncultivated land is largely grown up in briars and bushes, between which broom sedge grows abundantly. The country in general has an aspect of disorder and unkemptness, an affect which is not changed by the farm buildings and fences, only too often badly in need of repair. The larger lowlands in contrast have kept up appearances.

The loess mantle provides largely a deep and rock-free soil. It is however a rather badly leached loess and was readily attacked by slope-wash and gullying. Good pasture grasses do not readily establish themselves in this area and the land goes from cultivation into a wild growth of weeds and bushes. One farmer

expressed the dominant practice thus: "We plant corn on a piece of ground for two or three years and then sow it down in red top and leave it until the broom sedge takes it. After that we plow it up and put it in corn again." This irregular cycle

FIG. 95. UTILIZATION OF LAND IN CROOKED CREEK SECTION, CRITTENDEN COUNTY.

occupies from five to a dozen or more years, depending on slope and economic conditions.

A large portion of the upland is apparently in a state of abandonment, or occasionally used for pasture. Next year, however, or the year after, these forlorn and neglected fields may be plowed up and cultivated for a year or several years. Practically the only land which is regularly cared for is in the creek bottoms or limestone vales. Here farm buildings are larger and better maintained. Here tobacco is also a valuable cash crop, creating incidentally a superior need of wood lots for stakes and firewood.

In the Crooked Creek section (Figure 95) there is but one tract of regularly cropped land, on a broad irregular bottom of Crooked Creek. Permanent pasture land also is not extensive. What is shown as such on the map is thus placed because it represents old fields that have been out of cultivation so long that there is little expectation of their return to cultivation. The difficulties of distinguishing between occasional crop land, abandoned land, and permanent pasture land are very real in this section. The irregular shape of fields, the presence in them of small clumps of trees and of gullied areas, the spattering of cultivated patches through old fields, these conditions add greatly to the confused appearance of the landscape and the difficulty of its cultural mapping.

More than half the cropped land in this section is in corn and the larger part of the remainder is in red top hay. A little wheat, oats, and peas are grown which may be "hogged down." Most farms have a small patch of sorghum. Orchards are old and uncared for. Tobacco patches are numerous, but small. Cattle and hogs furnish most of the cash income that the farmer receives.

Most of the farm houses are old, small, and in a poor state of repair. A number of the houses in the section are abandoned or occupied occasionally, depending on whether the land about them receives desultory cultivation or is entirely unworked. The entire section is a rather melancholy illustration of the partial exhaustion, not to say destruction of an area by a system of grain and tobacco farming to which its surface was ill suited. Part of the apparent decadence of this and adjacent areas is due to the fact that the population has found other places and means of subsistence, in contrast to the narrow ridgetop communities of the dissected Greensburg Area.

Clifty Areas: The undissected table-lands, especially in the north, where they appear to be covered with loess, support fairly prosperous farms (Figures 48 and 96). Tobacco is the

principal crop, grown with large reliance on fertilizer. The dependence on tobacco and the exigencies of its cultivation, concentrate the attention of the farmer on a relatively small acreage of cultivated ground, much of the rest of the ground commonly lying fallow. A migration of the tobacco patches from field to field about the farm is not uncommon. The density of farms is in general not great, Christian County having in its sandstone area an average of four to the square mile.

FIG. 96. FARM OF SUPERIOR TYPE.
This farm is located on smooth sandstone upland near Hardinsburg. The crop is One-Sucker tobacco in a field cleared two years previously.

The other type of land in this area is the limestone foreland of glady character, developed at the base of the escarpment and in the larger dolines. Here lay a belt of very early settlement, because it was the forest margin of the limestone plain. Excepting in its transition area into the plain this type of land is largely disused at present and contains probably the greatest number of ancient ruined cabins to be found in the Pennyroyal. (See Figures 44 and 45.)

The Glasgow Junction type section shows in particular the latter phase of country (see figures 49 and 50). A small body of permanent farming country on top of the escarpment is shown at the extreme north, with close clustering of farms on the smooth upland. The concentration of population in this section is in part due to the usual attraction of a pike for "crofters." The doline floors have been cleared, but are almost entirely out of use at present (Figure 97). The coves and glades in front of the escarpment contain small cornfields that have

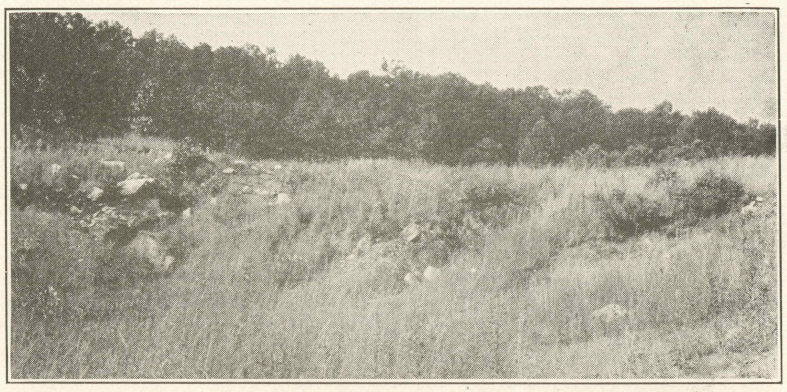


FIG. 97. BOTTOM OF DOLINE.
This view is south of Cave City-Mammoth Cave pike in Glasgow Junction section. The land has passed out of cultivation long since.

retreated into the floors of sinks, reproducing in exaggerated form the conditions described for the Elizabethtown Area, thin, weedy pastures broken by limestone ledges, ruined log cabins, and old-field timber (Figure 98). Thus does this belt show

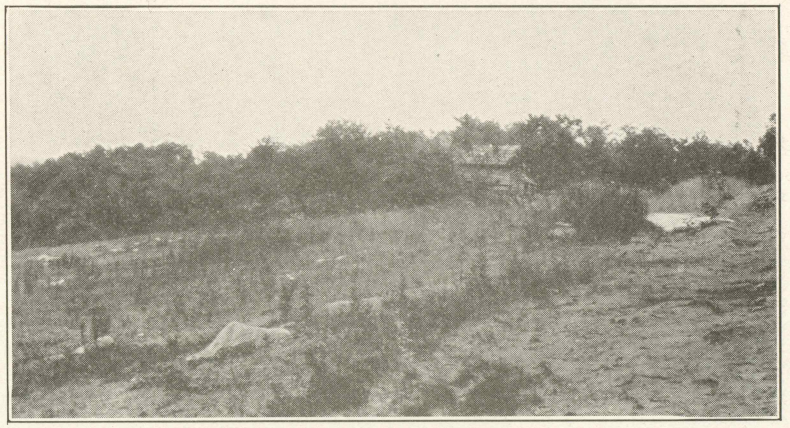


FIG. 98. RUINED CABIN.
This cabin and abandoned clearing is in the glade belt of the Glasgow Junction section.

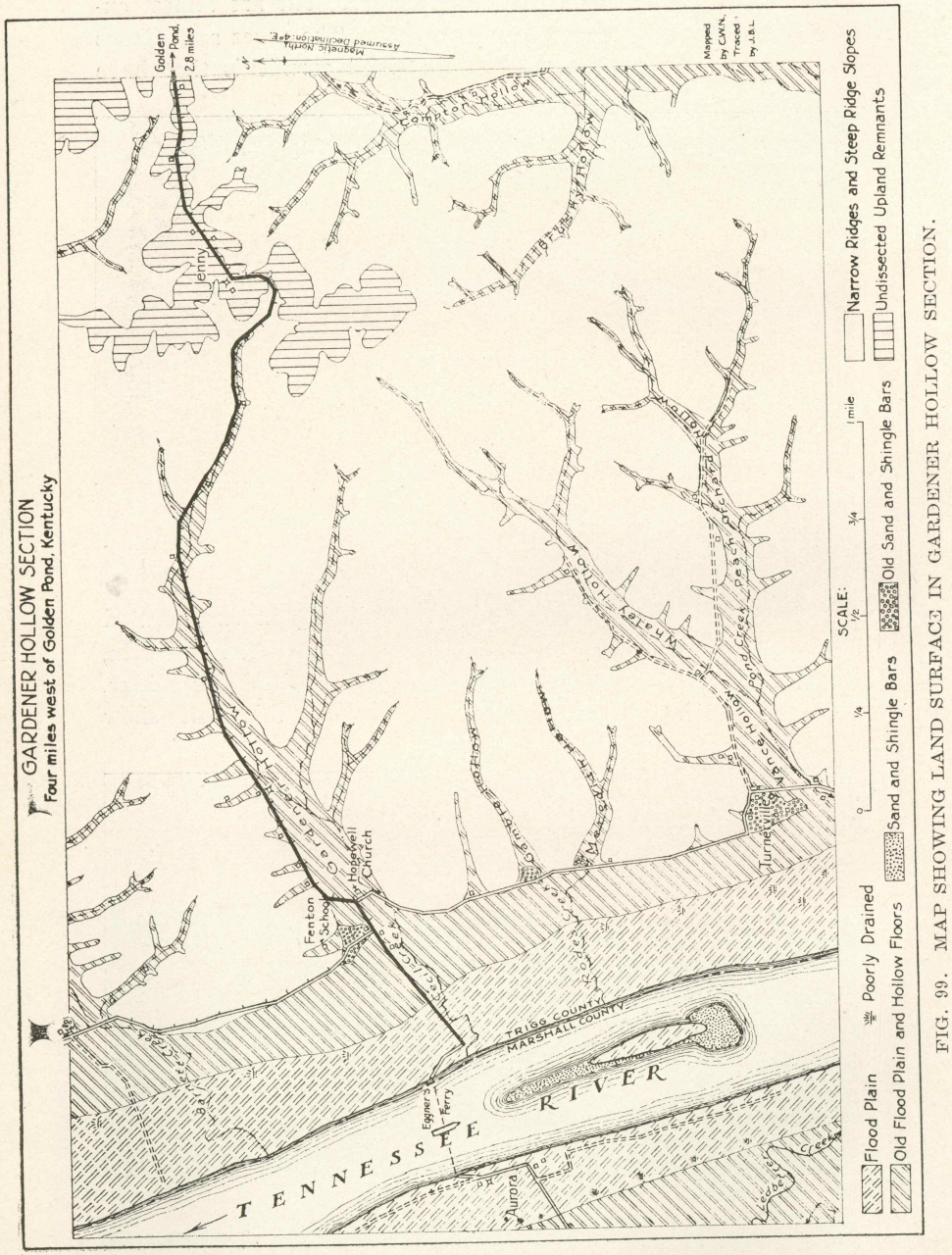


FIG. 99. MAP SHOWING LAND SURFACE IN GARDENER HOLLOW SECTION.

virtually the final stage in a cultural cycle begun a century or more ago.

Interfluve Area: The landscape here is dominated by forest, the dense second-growth that has sprung up over the "Coalings" (Figure 55). The farm lands form a simple dendritic pattern in the main that outlines the valleys, large and small. In small measure upland areas have been cleared on undissected flats. These however have thereby been subjected in large measure to erosion (Figure 53) and hence have gone out of cultivation in considerable part. Even many of the upper "hollow" floors have proven so stony and thin as to soil that they have reverted to pasture or have been abandoned. The major concentration of population therefore has been increasingly toward the river margins and the adjacent broad lower parts of the hollows (Figure 56). The "sags" in the river valleys offer occasional farm land, but are not used in years when high water comes during summer, or even late spring.

The extent of forest land causes it to be of considerable importance to the population. Tie making in particular is an important occupation during the winter season. Numerous hogs roam about the woods, sustaining themselves almost entirely from the mast and reverting in the process to nearly wild condition. Some attempt has been made to establish sheep ranches in the rough land, but with little success as yet. Much of the ridge land is in large holdings, one St. Louis company, legatee of the old iron industry, owning about 55,000 acres in Trigg and Lyon County. This company furnishes employment to local tie-cutters and its lands help to sustain the free-ranging hogs of the natives.

The Gardner Hollow type section (Figures 52 and 99) shows the river valley and hollow settlements along the Tennessee and the clearings on the upland at Jenny. The houses are most commonly placed at the mouths of the hollows, especially on the gravel bars common at such a place (Figure 100). Here there is protection from all floods, good drainage, ease of digging wells, and a junction of roads. A resemblance between the rugged portions of the Interfluve Area and the Mountains is sometimes remarked. The smallness of the farms and their poverty, the small, unpainted cabins, the large amount of

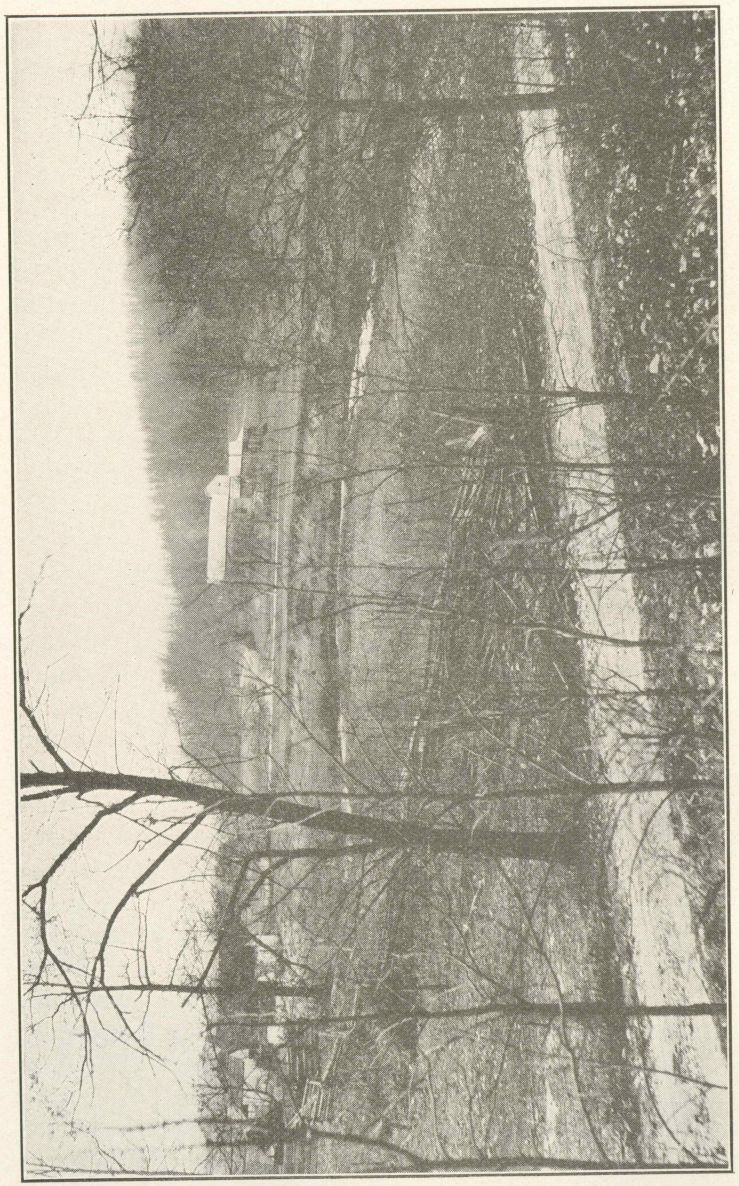


FIG. 100. FARMSTEAD GROUP.
These farmsteads are at mouth of a "hollow" on the edge of the Tennessee River bottoms, in the Gardener Hollow section.

timbered land, the isolation and backwardness of the communities, are common to both areas. Tenancy is infrequent; negroes are wanting in many parts and moreover are not wanted, though in truth there appears to be no desire shown by members of the colored race to immigrate. Corn is the principal crop. Hogs, cattle, and ties are the principal articles exported in payment for the meagre purchases from the world outside.

Mountain Margin: The farms of the limestone piedmont are ample in size and comfortable in appointment. Corn and livestock are the principal products and are produced in goodly surplus over farm needs. Farms of two or three hundred acres, mostly in cultivation, are not uncommon. Tenant or hired labor is either negro or Mountain white. Most of the houses and their premises are well cared for and roomy. A most important factor in the location of farm houses is the distribution of springs. Since these are grouped especially along the upper margins of the Cumberland, at the base of the Mountain escarpment and at the base of the larger knolls, the farmsteads are clustered about these features and the farm boundaries are more or less transverse to them.

In the "breaks" the most of the farms are on ridge tops. The cultivated area is small and shrinking. On the cavernous limestones the red sub-soil is all too apparent at the surface. As in the Elizabethtown Area, the cornfields have retreated into the sink floors. The older farms, some of them once having extensive improvements, are strongly decadent. Some of them are ruins in the midst of broad abandoned acreage. The establishments of recent date are much less pretentious, and in many cases are located in the upper part of the steep breaks. A semi-final stage of destructive exploitation of unstable slopes and shallow soils has been reached here in many cases.

The coves, reentrants between the Mountain spurs, on the eastern margin of the area, contain fine farms in the larger and smoother basins. The smaller coves on the other hand show decadence except where they have received more than usually careful cultivation. These coves were the zone of earliest settlement in the eastern area. Usually the oldest homesteads were built on the limestone land forming the lower slopes of the Mountain front. Not a few of these old farm yards are today almost bare

rock ledges. The smaller coves have therefore gradually lost their earlier attractiveness and increasingly have become the home of an unaspiring or unassuming population that has moved in from the Mountains. Newer fields have been found on the

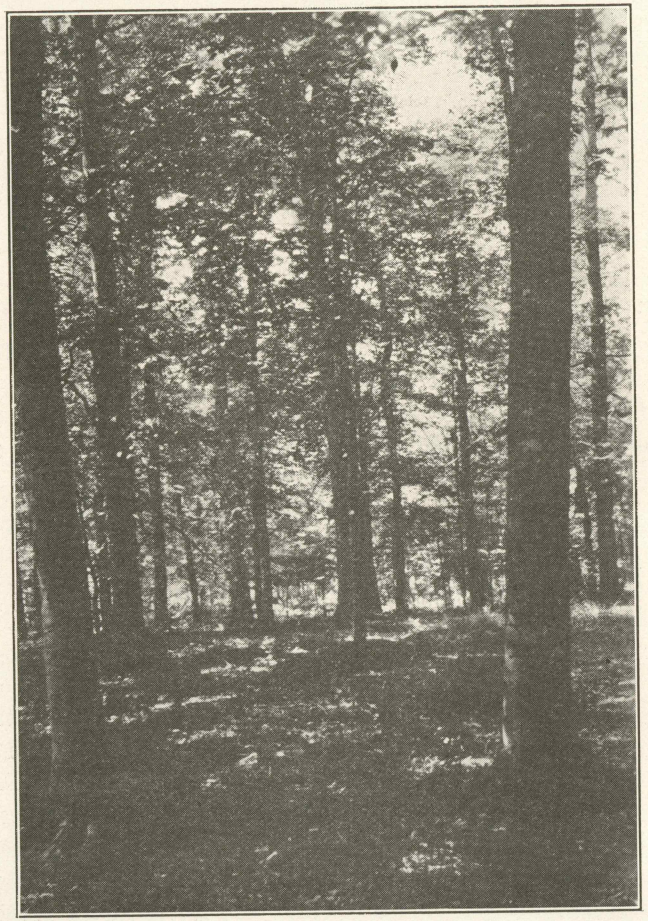


FIG. 102. BEECH FOREST.

This view in the Salt Lick Bend section shows forest on poorly drained "tight" bottom land.

saddles and higher slopes of the ridges, lying in some cases at very steep angles. If these slopes are sufficiently covered with sandstone waste from the Mountain crests they may be fairly

stable under reasonable management, though their productivity is not high and the labor of tilling them is arduous.

Cumberland Enclave: In contrast to all the other areas, the communities here are centered upon valley floors. Due to

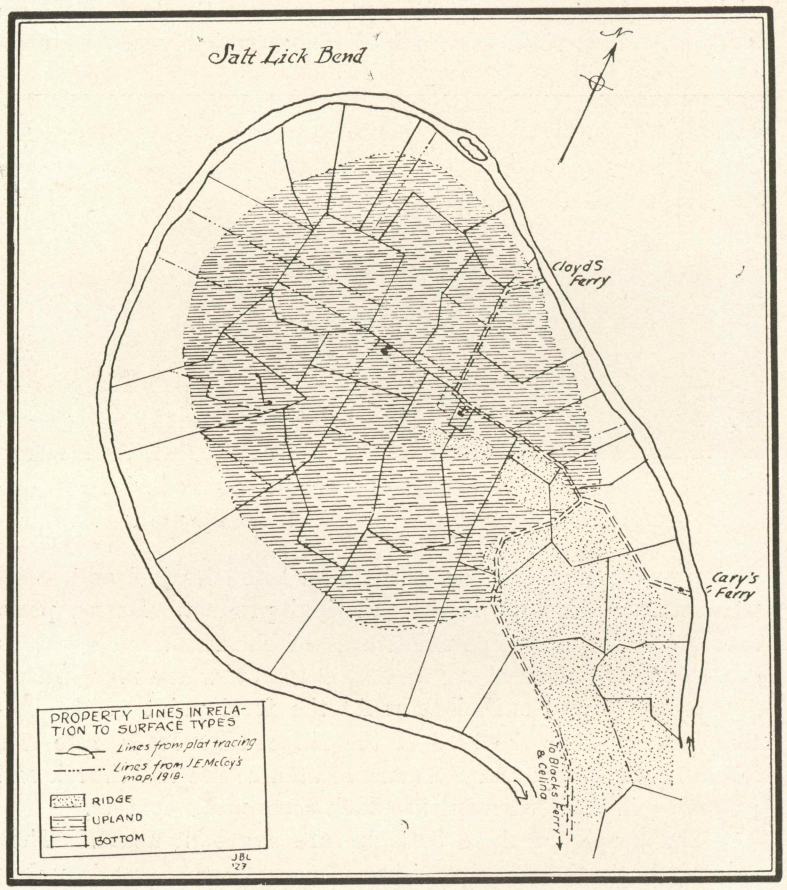


FIG. 103. PROPERTY LINES IN RELATION TO SURFACE TYPES.

the great floods of the river, and the minor but frequent freshets of the creeks, buildings are generally not found on the flood plain, but are located on slipoff slope, terrace, or the colluvial foot of the valley-side. Beyond the river and the large creek valleys is the largely unoccupied marginal hill belt, with an occasional farm in a creek bend or on a ridge remnant. The river

bottom communities are in general densely settled, and in many cases the subdivision of holdings has replaced the older, large farms by farms that are rather cramped.

The flood plain lands are planted regularly to corn and yield abundantly. Corn fields form an almost unbroken ribbon along the river. The lower slipoff slopes and terraces are ordi-

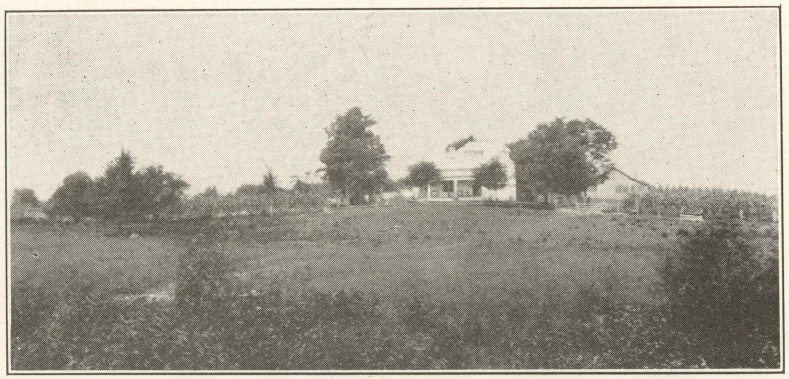


FIG. 104. FARMSTEAD IN THE "BOTTOM."
This view is characteristic in the Salt Lick Bend section.

narily pastures or hay fields, the land being leached and somewhat sour. Livestock is the principal product. Barns, pens, and sheds are conspicuous features of the farm landscape in contrast to the Greensburg upland adjacent, where many farms have scarcely any outbuildings At the focal point of the bottom, usually near the base of the ridge that leads into the "bend," the school and store are located as are the church and postoffice, if the settlement has such community centers.

The people of these bottoms are a group apart. They scarcely know the meaning either of poverty or of weath, unless they have given profitable oil leases. They have introduced such mechanical conveniences as are of use to them. Rural telephone lines were built here to connect them with outside communities before they were to be found in most parts of the state. A few automobiles are kept, but local transportation is still largely by horseback. The points of a good saddle horse are well valued. Their neighbors of the ridges call them a "clever" people, implying that they are both able and agreeable. A quiet dignity

and courtesy, reminiscent of an elder day, are native qualities of these upstanding yeomen. Clear-eyed, well-grown, and alert, these people harmonize well with the fair, far valley to which they belong.

The cultural conditions of Salt Lick Bend are shown in Figure 101. Wherever slopes allow, the land has been taken under cultivation, excepting for some tight, low land which may still be reclaimed by drainage, but is now in forest, mostly of beech (Figure102). Most of the flood plain, even the silty inner margin, is regularly cropped to corn. The leached higher alluvium of the terrace land and the slipoff slopes are in part damaged by soil erosion and are less carefully cultivated. The farms are in general divided between first bottom and "upland" in such a fashion that the land-holdings of the "bend" give a spoke-like pattern. By subdivision of property a number of less good farms have formed that do not have a share in the prized bottom land (Figure 103). The bend was originally settled by two families, and virtually the entire population is descended from these two groups, now allied by intermarriage. A good type of local farmstead is shown in Figure 104. The farm houses are grouped along the two roads leading to the ferries. All buildings of the community are placed well above the level of the flood plain.

CHAPTER TEN

PROBLEMS IN CONSERVING THE LAND RESOURCES

Production vs. Exploitation

The utilization of land in the Pennyroyal leaves much to be desired from the standpoint of permanent maintenance of productivity. The land for the most part yields less than it did at the time of settlement, if tradition is to be trusted. The amount of land that is producing or which may be expected to produce largely is seriously reduced. Man has improved the land in the sense of placing thereon his buildings, of plowing the ground, and of enclosing it. For the most part however man has been also dissipating the real productivity of the land by acts over which individually he has little control. Largely his production has meant in reality exploitation. As a commercial producer his contacts with nature have been unfortunately in part destructive.

Destructive exploitation of the land has been favored locally by certain conditions of climate and of surface, but more so by the economic system of producing cash crops and by the possibility of exchanging worn-out land for new land. These conditions are perhaps most marked in the southern states, but they are not a matter of reproach to the population. The damage that has been done is an expression of the involuntary and almost inevitable result of the economic system by which new areas have been exploited as sources of new materials for older countries. The local area is one of a great number of illustrations of the commercial era as a period of almost incalculable terrestrial alteration.

Drainage of Wet Land

Amelioration of land quality is to be found locally chiefly in the reclamation of swamps. The soil of the local swamps initially is not very productive. Both upland and bottom swamps for the most part have been subjected to leaching sufficiently long so that much of their soluble plant food has been removed and the colloidal content of the soil much increased. They are in their natural condition very much subject to puddling when wet and to caking when dry.

Upon drainage the productivity increases gradually for a considerable period. Ditching, tiling, plowing, and the turning under of vegetation gradually loosen the land. Aeration causes the structure of the soil to become more crumb-like. Plants become better rooted and withstand dry weather better. If the drained swamp soil can hardly be said to become mellow its improved physical condition causes it to work more easily and to yield more abundantly. Usually in such reclamation lime is used as an aid in mellowing the soil.

Because of their smooth surfaces and protection from erosion the local swamps are increasingly desired. They are however costly to reclaim, clearing, liming, and the finding of an adequate drainage outlet being troublesome problems. To reclaim some of them drainage engineering is needed. The small size of the individual swamp and the economic status of the population result ordinarily in home-made plans and execution of drainage. The total amount of land thus reclaimed in the Pennyroyal is only a few thousand acres.

Loss of Fertility by Removal of Crops

Crops removed from land obviously result in the abstraction of mineral substances from the soil. The same substances however are being replenished by the weathering of the sub-soil. How rate of removal and rate of restoration compare can be determined only by an exhaustive series of soil analyses over a considerable period. Such figures are not available locally. Loss of soil fertility also is probably a much more complex matter than can be determined by chemical analysis. It means certainly only that less plant food is available for crops than was formerly the case, and it may indicate a change in condition of soil other than its mineral constitution.

Statistical evidence of reduced fertility directly by cropping is probably not available in the Pennyroyal: 1. Returns of yield are available only for one year in ten. 2. Within that period a migration of crops has taken place on very many farms, so that in large part the comparison would be of different producing areas rather than of production on the same fields. 3. Economic attractiveness of individual crops had changed and therewith the nature of cultivation. 4. In particular, census

data give no basis for separating eroded from non-eroded farm surfaces.

It is believed generally throughout the area that the yield of wheat has decreased of late years, even on the smooth lands that are not subject to slope wash. An average yield of eight to twelve bushels is about normal expectation in the better and smoother limestone lands, where soil erosion is not effective. Farmers and millers say that formerly much larger yields were secured on the same lands, a generation ago the yield being reported as twice as large. It is notorious that the good Mammoth Cave limestone lands, selling for a hundred dollars an acre and up, produce very mediocre yields of wheat, yields so poor in fact that wheat growing is continued for reasons quite other than its direct return. Some of these same areas once produced flour for export. Mills, where still extant, now import a large part of their wheat, both of hard and soft grades. The growing of corn on similar land is apparently nearly as successful now as at any time in the past. The production of clover commonly is said to have become more difficult. The maintenance of hay fields in general appears to involve an increasingly serious contest with sour-land grass that tends to encroach on such fields.

In general it may be said that the Mammoth Cave limestone lands and the alluvial lands require least use of commercial fertilizer. It is however employed on both types of land, on the upland especially in the production of tobacco. On the shaly limestone, sandstone, and thinner loess lands, the farmer buys as much commercial fertilizer as he can afford, the type varying with the crop. The sandstone lands in particular are strongly dependent on potash and phosporous combinations.

The increasing difficulty of wheat production on good limestone lands appears to indicate the growing deficiency of readily available phosphorus in the surface soil. Corn is not affected similarly, probably because its roots penetrate more deeply. The difficulty of maintaining a stand of clover indicates increasing soil acidity, perhaps in part a condition of exhausting the lime content. The insufficient use of stable manure in almost all sections of the area has aggravated the decreased productivity of the soil by the reduction of beneficial organisms and

organic solvents. The following table illustrates for two types of land the possibility of overdraft on available plant food.

Average plant food in surface soil (seven inches), pounds per acre:

	Mammoth Cave	Chester
Total Nitrogen	2,106	1,700
Total Phosphorus	891	702
Phosphorus, easily soluble	18	6
Total Potassium	28,220	26,560
Potassium, easily soluble	320	218
Calcium, easily soluble	2,210	1,530*

*Ky. Agric. Exp. St. Bull. 193, Table 8 and 9.

Soil Erosion

Soil erosion does not assume in the Pennyroyal the startlingly conspicuous forms that are familiar farther south. Great gullies in general cannot form because bed rock is ordinarily at shallow depth and because protecting forest belts are very numerous. Soil wastage is rapid and serious over the greater part of the local area however. It is probably no exaggeration to say that two out of three acres of improved land have been appreciably damaged by wash. Previous chapters have called attention to the location and manner of soil damage. The physical type maps show characteristic distribution of eroded surfaces. They represent however only advanced conditions, implying actual or expending extinction of agricultural value. For the most part slope wash is wanting only on the brown Mammoth Cave lands, the Taylor and Adair section of the Waverly surface, the first bottoms, and the swamp lands. On the other surface types a persistent and increasing destruction of land fertility is proceeding by surface wash. In the century and a quarter of occupation the actual productive basis has been greatly narrowed in area, setting up local migration of crops and of farmers toward the smooth lands and also a fugitive occupation of still rougher lands.

The causes that are responsible for this condition are similarly at work in adjacent areas and in general become more effective southward: 1. The erosion of cultivated land is partially induced by climate. It is much more serious in the south than in the north, without assigning thereby better agricultural practices to the north. These handicaps of climate are principally: a. An insufficient annual loosening of the soil by frost. Frost ordinarily penetrates the ground in the Pennyroyal to a depth of from six inches to a foot. The ground usually does not remain frozen through the winter. In contrast to conditions in

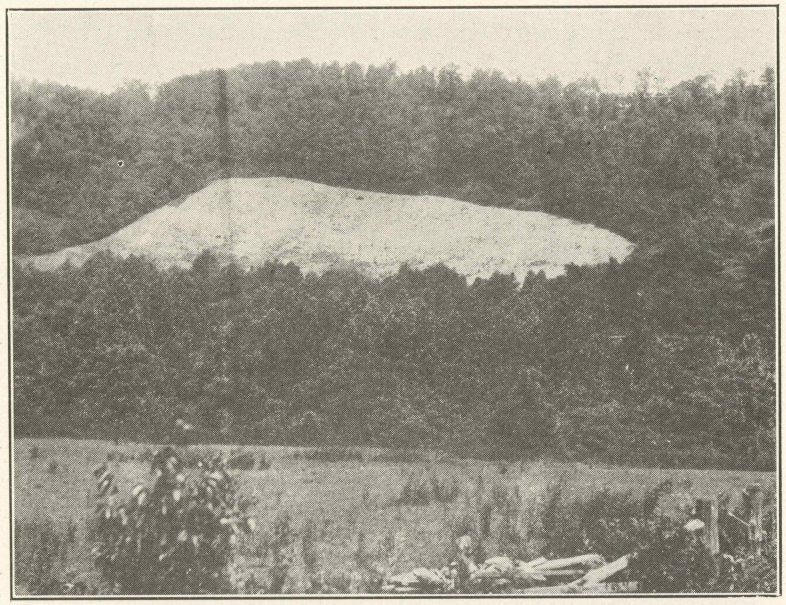


Photo by Stilgenbauer.

FIG. 105. CORN FIELD ON THE STEEP HILLSIDE.
This farm is located on White Oak Creek, Wayne County.

the Gulf states, frost still is locally a boon. The soil tends to become compact under cultivation however and freezing is insufficient locally to overcome this tendency. b. In most years the ground is subject to alternating freezing and thawing, which aids soil creep powerfully. c. Snow falls in small amount and soon melts. Winter precipitation is greater than during summer, comes in the form of rain principally, and washes the ground vigorously because the fields are usually bare. d. Much of the summer rain comes in the form of heavy thunder-showers, resulting in rapid run-off. e. The long warm season stimulates the growth of these soil organisms that break down the organic matter in the soil. Kentucky soils are rarely black as even inferior soils in the north may be. The better local soils have a chocolate color, indicating both good aeration and a fair organic

content. Such soils are fairly well able to absorb rain because of their porosity.

2. The crops grown are less likely to protect the land from slope wash than in the north. In particular hay is relatively an unimportant crop, and hay composes a majority of the improved surface in many northern areas. Wheat is not grown very extensively. Commonly, there is no crop that covers the ground in winter. The major crops have been corn, tobacco, and at times, cotton, all of them clean cultivated and largely ineffective in preventing slope wash even during the growing season.

3. The soils of the Pennyroyal are greatly older than the glacial soils of the north and most of the soils of the west. They have decomposed farther and form on the average heavier soil, of low permeability to rainfall. 4. Stock raising is not extensive. The amount of manure available has not been great and, largely, it has not been carefully applied.

5. In many sections locally the pressure of population has led to the clearing of more and more steep slopes even though it is well understood that the land will be abandoned after a few years of cultivation. Most of the "deadenings" and stump fields now being cultivated will be abandoned in all probability before the stumps have rotted out. In the breaks of the Cumberland from three to six years is the average life of a cultivated field. In that period the field will yield a sufficiently good return, enriched as it has been by forest mold, to satisfy the cultivator. When the organic matter has been sufficiently reduced erosion sets in and proceeds vigorously. Small farmers utilize in this manner slopes of twenty and even of thirty degrees, choosing surfaces that are initially nearly free from stones (Figure 105).

The first effect of soil wash is seen in the color of the soil. The surface soil in undisturbed Mammoth Cave areas is brown. Most of the rolling lands of this formation have a brick to blood red color, the normal color of the sub-soil. In this case the surface soil has been removed, for, where such lands have not been cultivated, a thin brown top-soil is present. On the Waverly formation the sub-soil is yellowish and in the Chester reddish. Incipient soil destruction is therefore indicated ordinarily by brighter color of the land as against the uneroded fields. In

general the erosion of cultivated land is closely correlated with slope and is prevalent on most unforested slopes above five degress unless they are very short. In lesser degree it is related to kind of rock formation, though, as previously stated, the distinction between magnitude and obviousness of soil erosion is hard to draw on a formational basis.

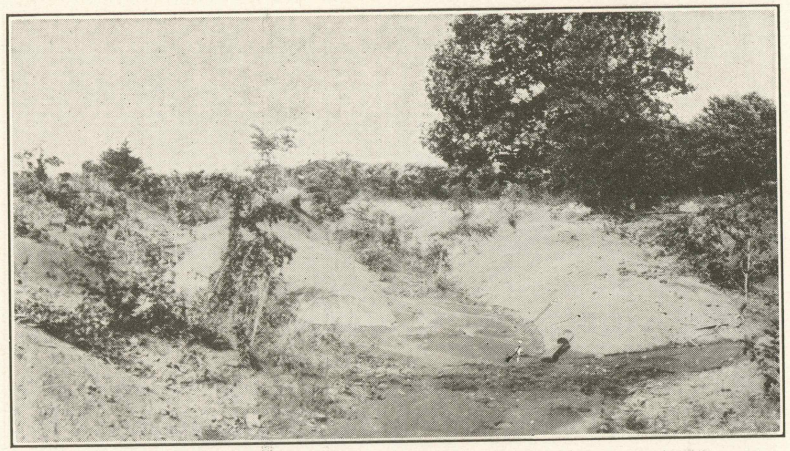


FIG. 106. ABANDONED FIELD.

This view shows characteristic erosion on ridges in dissected uplands Waverly materials, near Blackgnat, Green County.

The next step in soil removal is seen in incipient "shoestring" washes, formed between the furrows (Figure 53). Later, these grow into dendritic gullies where depth of soil permits (Figures 106 and 107). Especially in the cavernous country the eroded material is in large part redeposited nearby in sink floors, as shown in Fig. 107. Over the margins of the Mammoth Cave limestone areas the material is so thin that glade surfaces develop, the bed-rock being proof against gullying and much of the soil material being carried underground through fissures (Figures 44, 45, 47, 61, 97, 98).

With serious erosion cultivation ceases. Blackberry briars, dewberry vines, mullein, ironweed and milkweed, persimmon and sassafras sprouts, fortunately repossess the land rapidly and arrest further soil removal. Lately in old fields scrub pine (P. Virginiana) is becoming increasingly abundant. The blackberry is perhaps the most characteristic growth of worn fields, growing

in great profusion over all the eroded areas, ready to invade any open land on which cultivation ceases. In the protection of surface the dewberry plays a particularly important role, taking

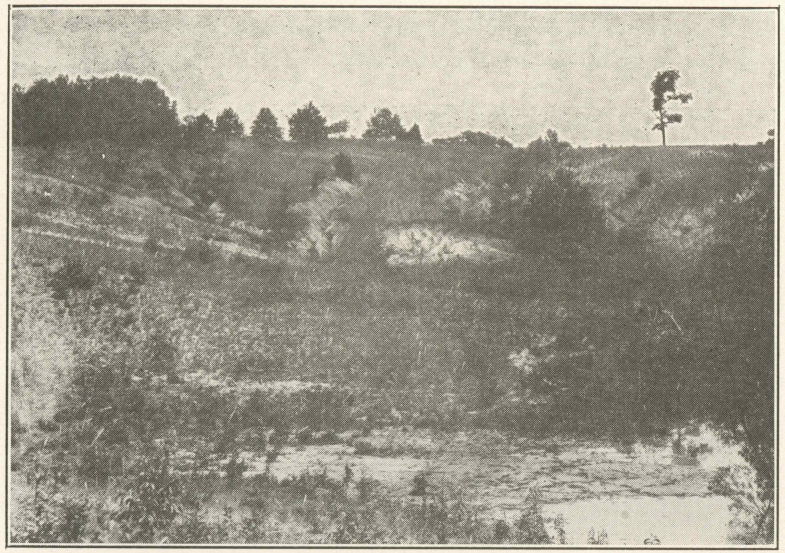


Photo by Stilgenbauer.

FIG. 107. OLD FARMS ON CAVERNOUS LIMESTONE.

This area is immediately north of Mills Springs, Wayne County, and has been eroded so badly that most of it is abandoned. Every stage of erosion of fields and of their repossession by vegetation may be observed here. This view is taken from the floor of a sink.

root within the small gullies and protecting them shortly with a cover of vines and leaves. On the limestone ledges red cedar is the most distinctive growth.

Control of Soil Erosion

The principal control of soil erosion is by the natural succession of vegetation just sketched. It is an effective solution but not an agricultural solution. Those farmers who have turned to producing livestock, with consequent increase of hay and pasture land, and the application of stable manure to their fields, are on the road to a permanent agriculture. A few farmers have succeeded in banking earth at short intervals on slopes and in maintaining brush dams across gullies, but these measures are

those of retardation rather than of healing of slope wash. More winter crops, such as rye, are much to be desired.

The whole problem is very difficult. In large part soil erosion results from increasing need for plow land. It is worst in the poorest districts. Such farmers cannot equip themselves for livestock production. They cannot acquire or manage the larger areas that make a conservative rotation of land possible. They cannot incur the expense of more careful tillage. As the contest with erosion becomes acute, the better farmer is likely to go. The poorer farmer then takes over the land, an apathetic onlooker of conditions he thinks himself powerless to control. In the end, he too moves on, probably to liquidate another bankrupt surface.

Problems of Reforestation

The extension of farm land appears not only to have reached but to have passed by a decided margin its economic limits. Nearly half the area of the Pennyroyal is wild land, or forest land of some sort.

The forest land has supplied the local farms with more materials than the usual wood lot. Fence rails and farm lumber, wood for household fuel, curing tobacco, and for burning the seed beds, stakes for drying the tobacco stalks, are the most common products. The better trees have been cut for ties and merchantable logs. Mast and grazing are important. In the forested slopes lies perhaps the largest undeveloped or rather temporarily reduced asset of the region. For the most part the reconstruction of the forest resource must be brought about through the farmer. The ownership of this land is prevailingly by farmers and is likely to remain in their hands.

The Pennyroyal is a most attractive region for forest production. It lies in the best part of the range of the valuable yellow poplar, which in former days was rafted and hauled out in large quantities. The growth of this valuable wood is almost as rapid as that of pine in the Lake states. Oak, hickory, maple, and ash thrive, and red cedar is to be found most numerously in this state and in Tennessee. Other valuable local species are the cucumber tree, basswood, walnut, and beech.

A timber count in several wood lots gives an idea of the diversity of species and of density of stand. Each count was made for an acre of representative type.

Plot I

Type: steep, shaded valley slope; Cumberland River, one mile below Mill Springs.

	Diam 18″ up	8″ to 18″	2″ to 8″
Chestnut oak	11	7	0
Red and other oak	5	0	24
Basswood	6	11	16
Hard maple	3	24	87
Yellow poplar	7	7	5
Beech	3	7	35
Cucumber	4	6	5
Ash	2	8	27
Sycamore	5	2	2
Buckeye	2	0	1
Elm	1	5	8
Hickory	1	4	0
Water beech	0	2	8
Mountain ash	0	4	0
Witch hazel	0	0	7
Others	1	5	12
	51	92	237

The plot is of interest because it represents a location that has remained almost undisturbed by cutting or pasturing. The slope is too steep and unstable to yield good logs, but it illustrates in variety and density the nature of forest growth on well shaded slopes.

Plot II

Type: Full southern exposure: located nearly opposite Plot 1.

	Diam 18″ up	8″ to 18″	2″ to 8″
Cedar	2	27	62
Beech	11	7	0
Maple	6	0	0
Chestnut oak	2	0	1
Elm	2	2	1
Honey locust	0	2	14
Walnut	0	7	10
Others	1	3	16
	24	49	104

The slope was originally covered largely with beech, oak, and maple. The larger trees were cut out years ago and hogs have been allowed to run in the woodlot. The older beech and

maple trees are gradually dying, the forest floor having become apparently too dry for their maintenance. Cedar will soon be dominant on this slope. A more extreme condition of similar sort is illustrated by the next plot, an old woods pasture, that has been eroded by excessive enclosure of stock within it.

Plot III

Type: Full southern exposure; old woods pasture, opposite Mill Springs on north side of Cumberland Valley.

	Diam 18″ up	8″ to 18″	2″ to 8″
Cedar	4	56	215
Beech	12	0	0
Chestnut oak	2	0	0
Wild plum	0	10	30
Ash	0	1	13
Elm	0	3	10
Cork elm	0	0	10
Honey locust	0	0	6
Others	0	3	16
	18	73	300

The woodlots, largely deteriorated as to size and variety of timber, have been modified (1) by the removal of a large part of the more valuable timber trees so that the reproduction of the more valuable species is poor. Freely seeding species, with wind-blown seeds, such as maple, ash, and basswood suffer less in this respect than do yellow poplar, cucumber, walnut, and hickory. (2) Excessive denudation of sunny slopes has made the forest floor too dry for the continuation of the more shade-loving species that formerly throve in such sites, under full forest cover. (3) Livestock, especially pigs by their rooting, have destroyed seeds, seedlings, and sprouts in large amount and have disturbed the soil cover. The deterioration of forest site is therefore primarily a matter of check on reproduction of certain species and of drying-out of the forest floor.

The contrast of forest growth today with that of a generation ago is marked. Fifty years ago the following account was written: "The white oak, burr oak, and swamp white oak, form immense trunks, reaching to a height of eighty feet, where they still seem to be three feet in diameter. One could hardly determine which to admire most—their number, their size, or their grand uniform straight trunks. Although for thirty years the

trade in French butts via New Orleans has existed, one cannot see even that an impression has been made on the supply.''[1] Today only the most remote coves contain small stands that are still suggestive of such conditions.

The restoration of forest growth demands as prerequisite a sharp reduction in use of wood-lots for grazing and mast-feeding, the first step toward which is found in the introduction of ''stock law,'' as yet wanting in most of the more timbered counties. The local farmer could probably succeed fully as well with forest culture as does the farmer of the New England hills. Occasionally one finds a small patch of cedar or hardwood that is receiving protection, but there are not many. There is no more promising section of the country for growing yellow poplar, which does remarkedly well on shaded valley slopes, for walnut, which thrives on abandoned limestone fields if they are not too dry, and for cedar, on glade lands.

The forest problem is one of farm land utilization in the main. There are however possibilities of developing public forests, especially in the breaks of the upper Cumberland and in the Interfluve Area. Here are the largest tracts of land not in farm holdings, land which for its own protection should be kept out of farming use, and also the most numerous submarginal farms, for most of which there is little hope of betterment. Many of these farms cannot be plowed without erosion. Many are so thinly scattered over narrow ridges or along small, deep valleys that the development of a reasonable community life is out of the question. Their deterioration is continuing; their disappearance would be beneficial to the region and to the occupants of such places.

There are probably in excess of six hundred thousand acres in hills, flanking the Upper Cumberland, and more than three hundred thousand more ''between the rivers'' that could be blocked out in large tracts for timber reserves. Here is an opportunity for the future development of state forests, if provision is made to acquire such lands under tax forfeiture and by purchase at nominal prices. Then perhaps will again be seen the great gray boles of yellow poplar as principal pillars of a forest

[1] DeFriese and Hussey, Ky. Geol. Surv., Timber and Botany (1884), Pt. B, p. 15.

canopy in which beech, oak, and maple mingle. The beauty and wealth that once characterized all this hill country in place of the self-destructive exploitation and increasing economic distress of today may be restored. Such publicly administered lands would give decent employment and permanent support to a considerable part of the population that is now living precariously in the river hills. The ideal cultural condition of this landscape is that of a permanent forest economy, in which agricultural has a subordinate part.

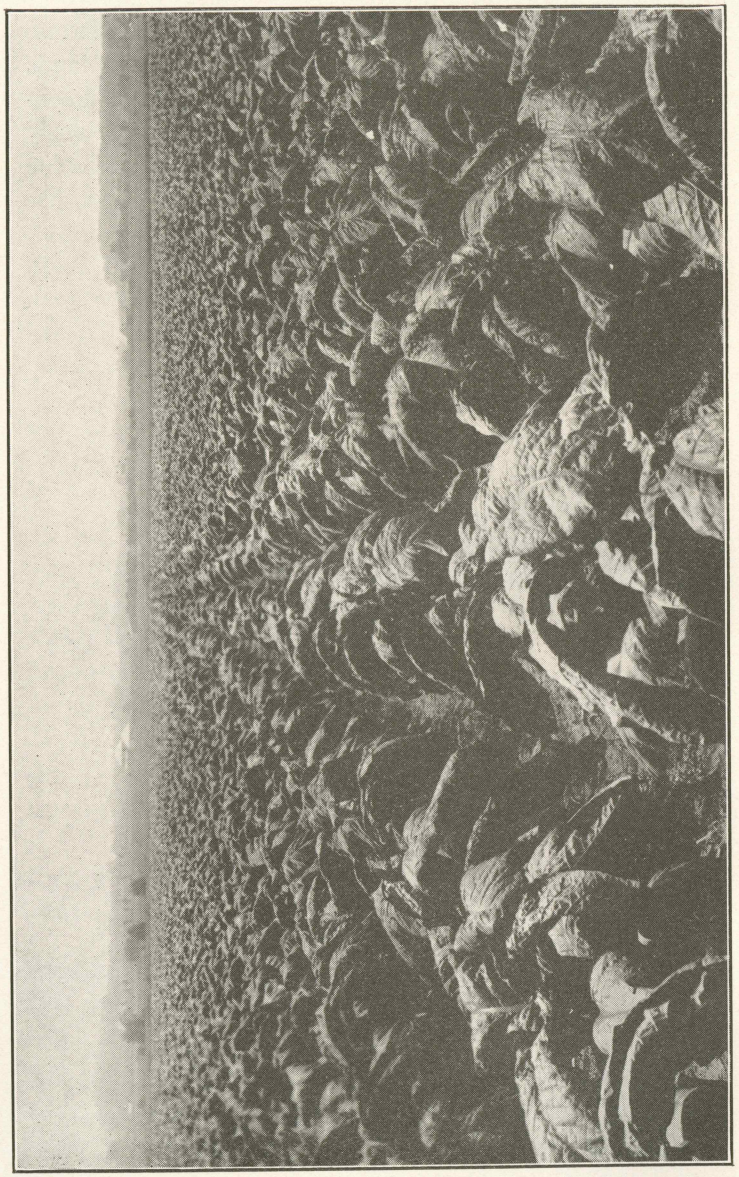


FIG. 108. DARK TOBACCO NEAR HOPKINSVILLE.
This field contains fifteen acres of tobacco which it was estimated should make 1,400 pounds per acre. The leaves of this tobacco are about 3' 8" long and contrast with the narrower Burley leaves which are about 3' long.

CHAPTER ELEVEN

FARM CROPS AND SYSTEMS

Tobacco: Cash Crop

The traditional money crop of the Upper South is tobacco. It was such in Virginia and Carolina in colonial times. When the colonist crossed the mountains he continued to grow tobacco, as usual, in new forest clearings. In Kentucky, in Missouri and Arkansas, and in the states north of the Ohio, Southern colonists appropriated virgin forest lands in order to grow tobacco on them. This original tobacco culture was an exploitation of the organic matter of new land, principally of forest leaf-mould. Soil and site mattered very little.

Here and there the industry continued after the peculiar virtues of virgin forest land had been used up. This was true where the Virginia tobacco planter did not move out, making way for later immigrants, differing in agricultural practice, but most especially where the mineral constitution of the soil was favorable to continued production of a choice quality of leaf. In Missouri tobacco culture was almost as important in the first half of the Nineteenth Century as it was in Kentucky. The Virginia-Kentucky planters in Missouri however were replaced or at least modified by large immigration from the Northeast and from overseas, with the result that tobacco growing has become almost extinct. There is no proof that Missouri lacks land physically suited to permanent tobacco culture.

In the Pennyroyal the organization of farming for the production of tobacco remained undisturbed. Tobacco was the common cash crop of this section. Gradually it became evident that the better limestone lands could be made to grow a choice leaf even after the land had been under cultivation for years. By 1840 the present distribution of tobacco culture in the Pennyroyal was already indicated; the earlier system of forest culture of tobacco was then beginning to decline and the Barren counties were emerging as great producers. In that year counties producing in excess of one million pounds were:

Leading Counties in Tobacco Production, 1840.

	Pounds	
Christian	3,409,000	(Pennyroyal Plain)
Todd	3,124,000	(Pennyroyal Plain)
Caldwell	2,568,000	(Limestone basins)
Barren	2,322,000	(Pennyroyal Plain)
Green	1,962,000	(Greensburg Area)
Trigg	1,880,000	(Plain mainly)
Breckinridge	1,807,000	(Clifty mainly)
Cumberland	1,480,000	(Enclave)
Livingston	1,223,000	(Marion Area)
Adair	1,030,000	(Greensburg Area)
Warren	1,030,000	(Pennyroyal Plain)

In 1920 the leading counties were:

Christian	24,768,000	(Pennyroyal Plain)
Logan	15,243,000	(Pennyroyal Plain)
Todd	12,214,000	(Pennyroyal Plain)
Warren	9,734,000	(Pennyroyal Plain)
Trigg	9,474,000	(Plain mainly)
Barren	8,008,000	(Pennyroyal Plain)
Caldwell	6,764,000	(Limestone basins in fault-block country)
Breckinridge	6,321,000	(Clifty mainly)
Simpson	6,058,000	(Pennyroyal Plain)
Hart	5,962,000	(Plain, Clifty, Elizabethtown)
Lyon	4,422,000	(Plain, Marion, Interfluve)

The only part of the Pennyroyal in which tobacco has never been an important crop is the Mountain Margin. In 1840 the Cumberland Enclave ranked with the limestone uplands in tobacco growing; tobacco patches in the Greensburg Area (Green County) were as numerous as in the cavernous country to the west (Barren County). In the eastern part of the region the industry since has largely disappeared. In the Pennyroyal Plain it has, however, become the dominant crop. Christian County now produces as much tobacco as did the whole region in 1840. Almost two-thirds of the tobacco production of the Pennyroyal is accounted for by the areas lying within the central Plain. The production of tobacco in the Pennyroyal is greater today than that of the State of Virginia.

Tobacco is the only crop of the Pennyroyal that has maintained a consistent and impressive growth in quantity and acreage, to the present. The acreage has nearly doubled since 1900, whereas the total amount of improved land has remained almost unchanged.

Size of crop in millions of pounds:

1840	1850	1860	1870	1880	1890	1900	1910	1920
26	30	52	41.2	55.6	54.0	66.4	98.0	141.5

The total value of the local tobacco crop in 1919 was $32,000,000, or 38 per cent of the total value of all agricultural crops, on one-tenth of the cultivated area. In Christian, Todd, Trigg, Caldwell, and Lyon counties the value of the tobacco crop exceeds that of all other crops. The year 1919 was a peak year in agricultural prices, but the ratio between value of tobacco crop and other crops has not changed much. The significance of these figures is increased by the fact that they represent essentially sales value, almost the whole crop being marketed. With the exception of the strawberry crop, restricted almost entirely to the vicinity of Bowling Green, tobacco is essentially the only local crop that is converted directly into money.

The relation between tobacco and soil type is far from simple. There are two principal types of tobacco grown in Kentucky, burley and dark. The Pennyroyal in the main is in the Dark Tobacco district, though the fairly important Elizabethtown and Greensburg areas produce principally burley. The state Experiment Station draws the dividing line between the two types from Cloverport, on the Ohio River, to Monroe County, on the Tennessee line, almost the whole length of the line lying within the Pennyroyal.[1]

The center of burley growing is in the Bluegrass. This tobacco is grown on at least three contrasted types of soil, the Bluegrass limestone lands, the Mammoth Cave limestone country of the Elizabethtown Area, and on the Waverly materials of the Greensburg Area. The center of dark tobacco is in the Pennyroyal Plain. It is also produced in the larger Pennyroyal on the Chester sandstone lands, on Waverly surfaces in Allen County, and on loess-covered uplands. Beyond the Pennyroyal it is an important crop on several soil types including alluvium, in the Jackson Purchase and in the Western Coal Basin. In the case of each type of tobacco the culture became established originally in a single area of distinctive soil conditions, which area in each case continues to be the district of most successful and most intensive cultivation. The Inner Bluegrass is still the principal

[1] Nicholls and Peck, Ky. Ag. Exp. St. Bull. 229.

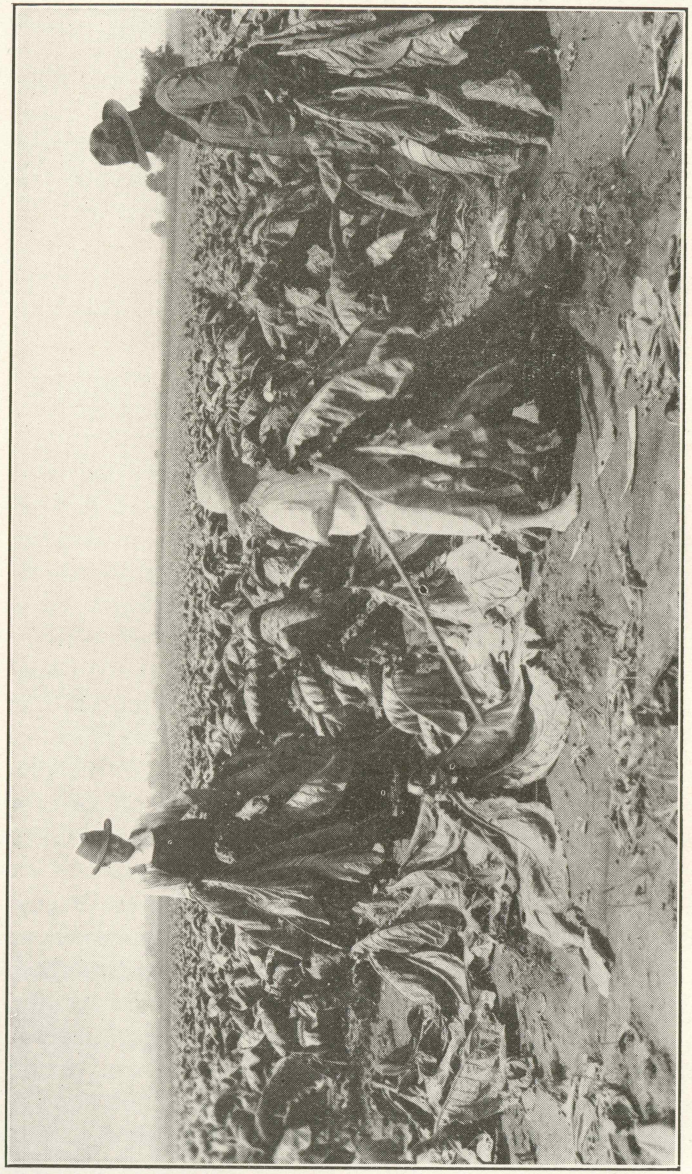


FIG. 109. CUTTING TOBACCO AND PUTTING IT ON STICKS.
After this is done it is taken into tightly closed barns to be cured over wood fires.

seat of the burley production. Christian County in the Pennyroyal Plain has been for a century the greatest producer of dark tobacco. This county has increased its acreage more rapidly than any other county in the Dark Tobacco district. Dark tobacco is a crop that requires a strong soil in order to make a good growth of leaf. (Figures 108 and 109). It requires however also in general certain qualities of soil, which are known only through trial by planting, in order to produce a leaf of a particular body and flavor. The Pennyroyal Plain apparently has the optimum conditions for the particular type that has become established as "dark."

The major tobacco growing districts have developed an economic structure that provides for the growing and marketing of these enormously valuable cash crops. For burley such markets as Lexington and Louisville are dominant, for the dark tobacco Hopkinsville, Bowling Green, Paducah, and Owensboro. Gradually adjacent types of land, largely divergent from the optimum soil areas, have been attracted into growing that type of tobacco for which a nearby market is established. These less favored areas have in general an abundance of farm labor. Tobacco makes extraordinary demands on labor, ten acres being sufficient to keep a family busily engaged. Such lesser sections have discovered that tobacco brings to them greater returns than other crops, even though it does not yield so well as in the major districts. Against the lower yields the farmer of the marginal districts can set cheaper land and cheaper labor, and the lack of fertility can be made good in large part by commercial fertilizer.

Thus the farmer of the sandstone table-lands north of Hopkinsville has forsaken his older economy and is now primarily a producer of dark tobacco which is taken down to the Hopkinsville market. He grows dark tobacco because he has available a dark tobacco market. With his tobacco money he buys corn, hay, perhaps even beans and potatoes, for he is too busy with his tobacco patch to raise much other "truck." Similarly, many farmers in the northern part of the Greensburg Area are growing burley tobacco because their market connections are toward the Bluegrass, whereas in the southwestern part of the same natural area they grow dark tobacco for another market. Increas-

ingly therefore the tobacco industry of Kentucky finds its explanation in the organization of particular markets and their accessibility, the original physical limits being disregarded more and more. Whereas the industry is breaking across soil limits it is at the same time becoming more definitely centralized about primary markets. Those sections that are remote from major markets are in general paying less attention to the culture of tobacco than formerly.

An increased mobility of farm population appears to be indicated by recent developments in tobacco growing. The farmer of the less good districts, as on the sandstone uplands, who has learned to prepare the seed bed and to care for the crop of dark tobacco and cure it, may have the opportunity of moving down into the richer limestone plain and of renting more productive land there. This has been true also of the farmers in the Greensburg Area with reference to the Bluegrass. A sufficient number of such farmers have been doing this sort of thing, especially in bonanza years, to suggest the probability of a continuing movement of population to the areas of greater attractiveness.

Corn, the Staple Farm Crop

Far more than tobacco, corn disregards boundaries of soil and topography. The growing of tobacco is definitely restricted to areas in which market facilities are well established. The cultivation of corn is independent of markets. Corn is grown on virtually every farm in the Pennyroyal. The amount that is grown is determined more by the amount of available plow land than by quality of soil. Over most of the Pennyroyal the ordinary one-man farm has about twenty acres of corn each year, irrespective of soil or surface. Twenty acres is considered about the amount that one farmer can take care of. According to Corn Belt standards this is a small acreage, but it is enough to keep the local farmer reasonably employed. Weeds grow rapidly; the land is more burdened with weeds and sprouts than in the Corn Belt. The texture of the soil makes it necessary to time cultivation carefully after the rains of early summer. One mule and a single cultivator take the place of the more elaborate equipment of the Corn Belt, the farmer's time being a less definitely recognized cost factor than machinery and additional draft stock.

The table given below (p. 202) shows that the amount of corn per farm varies only slightly in different sections. The amount of corn planted is if anything in inverse proportion to fertility. The poorer the farming section the more conspicuous are corn fields in the farm scene. In all sections however the larger part of the plowed land is planted to corn. About 28 per cent of the improved surface of the Pennyroyal is in corn, or about 60 per cent of the cropped surface. The acreage in corn has increased by about ten per cent since 1880, the most notable gains being recorded for the eastern counties, with losses in most of the northern ones.

The average crop is only about twenty bushels per acre. In money accordingly, it is not a particularly profitable crop. It outyields the small grains considerably however, requires less farm machinery than they do, and can be harvested at leisure and without the expense of threshing. The small size of farming operations makes production of small grains uneconomical by reason of the relatively excessive cost of machine threshing under such conditions. Corn furnishes grain and roughage for all stock and in considerable part the bread-stuff of the family. It retains its original importance in this area because the small farmer still has largely the same productive interests that his pioneer ancestor had. He grows corn because it is most useful to him, not because his land is particularly suited to corn.

The smallest farmers, those cultivating temporary deadenings and stump fields on hill sides, cultivate scarcely anything but corn unless they are so situated that they can market tobacco. Under the most extreme conditions corn is planted by hand and cultivated by hoe. A few acres will provide enough food for the family and a little for the chickens and pigs. As crowding becomes greater corn culture therefore assumes increasing importance as long as production is non-commercial. This is the explanation of the notable extension of corn growing in such counties as Russell and Casey. Where commercial production sustains an increasing farm population, tobacco replaces corn. On these two products rests the economy of agriculture

in the Pennyroyal, with the sectional modifications indicated in the following pages.

Areal Contrasts of Farming Systems

Selected farm data, 1919, as indicators of sectional contrasts :

	Value of Crops Per Acre of Cultivated Land	Grain Corn, Acres Per Farm	Forage Corn, Acres Per Farm	Tobacco, Acres Per Farm	Small Grains, Acres Per Farm	Hogs, No. Per Farm	Cattle, No. Per Farm
Pennyroyal Plain							
Christian	$65.00	13.9	1.9	7.1	7.2	4.9	3.1
Trigg	63.00	12.0	.5	4.8	2.8	5.8	3.4
Todd	62.00	14.1	.7	6.2	6.0	6.0	3.0
Logan	54.00	14.3	3.2	4.9	6.5	5.9	3.3
Simpson	48.00	16.6	5.4	4.0	9.8	8.9	4.0
Warren	44.00	16.6	3.6	3.0	5.0	7.2	3.9
Western Margin							
Lyon	60.00	11.2	.6	3.4	2.0	6.5	4.6
Caldwell	54.00	13.0	1.0	4.0	2.0	4.3	3.8
Crittenden	39.50	17.6	1.0	1.8	1.5	8.0	5.6
Livingston	36.00	19.8	1.2	1.0	4.6	10.1	7.4
Eliazbethtown and Northern Clifty							
Breckinridge	43.00	16.3	7.4	2.5	3.6	5.0	4.2
Hardin	26.50	16.7	9.7	1.0	7.5	7.2	6.3
Greensburg Area							
Metcalfe	41.00	11.0	3.4	1.9	2.8	3.1	2.6
Green	37.00	12.5	4.2	1.9	3.9	3.9	3.0
Adair	36.00	13.7	3.0	1.3	4.2	5.2	2.8
Taylor	35.00	12.7	6.3	1.7	5.8	3.9	2.9
Russell	29.50	14.1	5.2	.2	3.8	6.0	2.2
Enclave							
Cumberland	47.00	15.8	1.8	1.0	1.2	9.0	3.4
Mountain Margin							
Clinton	29.20	15.7	4.0	.0	3.4	6.5	2.9
Wayne	25.60	14.7	8.6	.0	4.3	6.7	4.0

The counties in the table were selected so as to identify as far as possible the physical contrasts of the area. Crop values have significance only as index of relative income per acre. The other items shown are the principal products of the area in terms of the farm unit. Figure 110 shows sectional contrasts in terms of utilization of total arable surface. The following areal contrasts in farming system are indicated in particular:

(1) The Pennyroyal Plain: Crop values are highest, due to maximum yields in almost all crops and to the prominence of tobacco culture. The eastern margin stands distinctly below

the more westerly counties in money values. The eastern counties pay more attention to stock raising and less to tobacco, though they are important growers of the latter crop. Forage corn and hay are grown extensively on the rather wet sink lands of the east. Warren and Simpson are the leading cattle counties of the whole Pennyroyal as to quality, fine herds of registered stock being nuemrous here. The greater importance of livestock in the eastern counties is partly due to the fact that the land is somewhat more rolling in character. In part however it is simply an historical condition. To the south of this area is the famous livestock country of the Nashville Basin. South of Hopkinsville is the Clarksville tobacco district of Tennessee. It is not known that the Nashville Basin is less suited to tobacco culture than the Clarksville area. Each has developed a successful farming system, with an adequate economic organization. Recent years of high prices for tobacco have resulted somewhat in an expansion of that crop at the expense of stock farming.

In Warren County an important strawberry industry has developed, this county leading the state in fruit production. Bowling Green is the principal shipping center. The local berries fill a gap in season between the berries from the Gulf States and those of the Great Lakes. The county is well situated for shipping to northern markets which it supplies at the same season that berries from East Tennessee and Southwest Missouri are shipped. Strawberries grow well on the well-drained limestone land. Tobacco growing has developed a rural labor supply that is not unfamiliar with the problems of truck farming. Local initiative and capital have succeeded in utilizing these opportunities in the strawberry industry.

The western part of the Pennyroyal Plain is the heart of the Dark Tobacco Belt. The whole farming system is centered about tobacco, which demands attention almost throughout the year. Tobacco is grown ordinarily in a rotation involving corn, wheat, and hay. For this reason wheat growing receives more attention than elsewhere in the Pennyroyal. Corn competes to a considerable extent with tobacco for the time of the farmer. The more tobacco is planted the less corn can be cultivated.

(2) The Western Margin: From the standpoint of farming system the western areas can be grouped together. In large

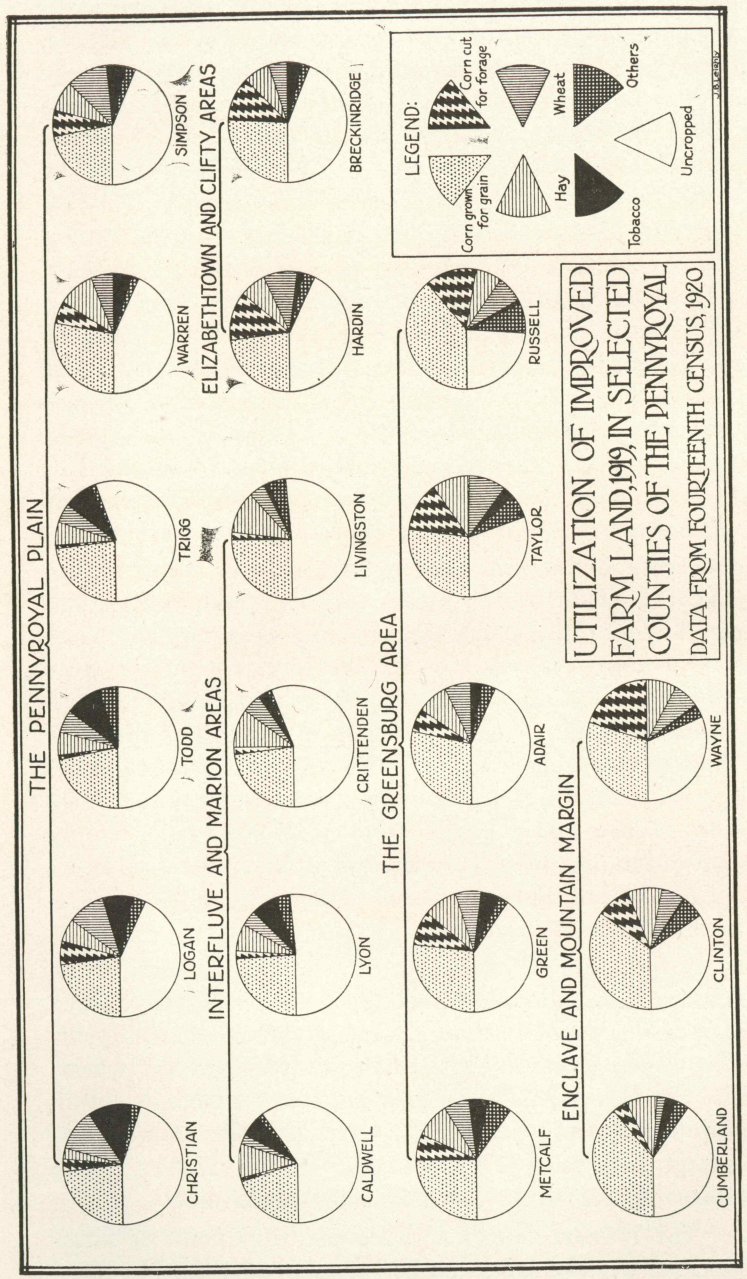


FIG. 110. UTILIZATION OF IMPROVED FARM LAND, 1919, IN SELECTED COUNTIES OF THE PENNYROYAL.

part they are variants of the Pennyroyal Plain in agricultural method. In Caldwell and Lyon counties tobacco is of greater value than all other crops. The unit of production is smaller than in the Plain but the ratio of tobacco and corn to improved land surface is about the same. There is simply much more uncropped land.

In spite of the apparent attraction to stock raising the cattle industry is as yet well developed only in Livingston and Crittenden counties. Hogs are more numerous in Livingston County than on the farms of any other Pennyroyal County. Caldwell, strongly occupied with tobacco growing on its limestone vales, has paid less attention to livestock. The low position of the small grains indicates much less attention to crop rotation than in the Pennyroyal Plain, as does the small amount of hay and forage corn grown. Tobacco is here produced more exhaustively and more directly through stimulation of land by fertilizer. In Livingston County there has been of late a notable increase in importance of cattle, suggesting the establishment of an agricultural system based primarily on livestock, in harmony with the slopes and soils of the country.

The least variable areal fact in the farming systems of the western half of the Pennyroyal, including the Pennyroyal Plain, is the percentage of arable land that is planted to corn. In all of the counties concerned approximately one acre in four of improved land produces corn.

Elizabethtown and Northern Clifty Areas: In the northern counties of the Pennyroyal the outstanding agricultural facts are: (1) In terms of improved land surface (a) a more extensive cultivation of corn than in the previously described areas, (b) greater amount of corn cut as forage, and (c) percentage of uncropped land similar to the better parts of the Pennyroyal Plain; (2) in terms of farm units (a) the largest acreages of corn for the Pennyroyal as a whole, (b) more than average attention to hog raising, and (c) highest rank in production of milk and veal. Tobacco, largely burley, is of intermediate importance.

The economy of this area it not strikingly differentiated according to its soil types. Perhaps because the land is more rolling and more eroded, tobacco is of less importance than farther

south. It is produced both on limestone and on sandstone lands, but principally in smoothly lying fields. The most important factor in the local agriculture appears to be the high accessibility of Louisville. Dairy farms are becoming numerous. The familiar milk-pigs-corn combination of dairy sections is plainly recognizable in the local farm statistics. Herein lies increasing hope for the rather badly worn lands of much of this area. They are after all still valuable limestone lands, though they have been much abused, and the nearness and demands of the Louisville market hold forth a promise of success for the newer, more conservative livestock farming.

The Greensburg Area: The most striking features of agriculture are the small size of the farms, the small amount of fallow land, and the large amount of corn grown. Metcalfe County has about a third of its improved land planted to corn, Russell more than half. In Metcalfe 45 per cent of the improved land is not cropped, in Russell less than 25. In the former county tobacco is fairly important, in the latter it is negligible; size of farm decreases from Metcalfe to Russell; with this decrease in farm size there is a corresponding increase in amount of corn grown on the individual farm. The five counties cited in table and figure form a series in which Metcalfe represents conditions of surface and soil favorable to larger scale farming and to commercial farming, whereas Russell is a county of self-sufficient ridgetop and creek bottom communities. In the latter county smallness of farm size, small proportions of fallow land, and large corn acreage are all expressions of pressure of population and lack of markets. The shaly Waverly formation, on which no exceptional crop yields are to be secured, supports the largest rural population, living in general by exhaustive farm methods. It is only by planting the maximum amount of land to corn that this population can be supported. Corn here is therefore an indicator of poverty of land.

The relative large amount of corn that is cut for forage is an important factor in maintaining livestock. The corn is planted in the hope that it will mature a crop of grain. On the thin ridges it is however subject to "burning out" during dry weather and is then salvaged as forage.

The Eastern Margin: Land utilization in the Cumberland Enclave and in the Mountain Margin is similar to that in the Greensburg Area. High percentage of improved land in corn and its inverse relation to fallow land again indicate land shortage. In the Cumberland Valley, the feeding of hogs, both on corn and mast, furnishes a commercial surplus. There is not enough available pasture land to enable much cattle raising.

Conclusion: The areas which produce a notable commercial surplus are the following: (1) the Pennyroyal Plain and dependent adjacent sections which specialize in tobacco, (2) the eastern Pennyroyal Plain which markets strawberries and livestock, (3) the counties near Louisville which market dairy products, tobacco, and pork, (4) the Ohio River counties in the west which have a surplus of cattle and pork, (5) the smooth land in the Greensburg Area, producing tobacco in small surplus, and (6) the Cumberland Valley, which sells pigs. For the most part the eastern counties are lacking in any commercial basis of agriculture. Here almost all farms are operated by their owners. In the tobacco districts tenancy is highest and the percentage of negro population greatest. Tobacco is generally an indicator of smooth land, in part of fertile land. Corn increases in significance with decreasing quality of land and decreasing size of farms. Where inferior land and larger farms are the rule, as along the Ohio River, livestock is of dominant importance. Size of farm and percentage of improved land under crop are in no regular relation to fertility of land.

CHAPTER TWELVE

FORMS OF TRANSPORTATION

Development of the Transportation Net

The highways of the region are an expression alike of physical build and of cultural history. As cultural forms they have passed through a series of stages. The relation of the region to outside areas has been fundamentally the same throughout its history, namely, it has at all times served as corridor (Chapter II). The changing economic systems of the Pennyroyal have resulted in successive adaptations of highways to the persistent corridor character of the area. These changes in communication are due primarily to historical changes in forms of communication, in type of export, and in concentration of population.

Until about 1820 the region contented itself with flatboats that carried the heavy freight down river, with minor use of keel-boats that could be taken upstream, and with numerous wagon roads, for the most part traversing the "Barrens." Though some of these early roads were called "pikes," their improvement at most consisted of throwing up the dirt from sides toward center. In addition to the main roads between Bluegrass and Ohio River on the north and the Nashville Basin to the south (Chapter II and Figure 74), as counties were organized, the county courts instructed the laying out of roads that focussed on the county seats. Changes in general have not been made in the county seats, and nearly three-fourths of the counties were established by 1820. These early roads, centering upon the court towns, provided therefore the major present pattern of highways, subject since then only to minor relocations. The most important connections of the county seats were with the navigable rivers and with the through roads that crossed the area.

With the development of steamboat navigation, after 1820, river landings grew into commercial towns and the improvement of roads became a major issue. The improvement of river navigation and the building of permanent wagon roads became the major objectives of internal improvement until the time of the Civil War. The rivers are distinctly marginal to the better farm-

ing sections of the Pennyroyal. To make them accessible to the goods of the region required road-building. The Big Barren River alone is really central in location. Its improvement was therefore of particular importance at this stage of development.

No one of the rivers was without difficulties to navigation in its original condition. In each case the problem of improvement involved cooperation with other sections. The navigation of the Cumberland was primarily a problem of the Nashville Basin. With extreme fluctuations in flow, with many reefs, bars, and snags, the Cumberland has been a very difficult stream to improve.[1] Low water, according to river usuage is the stage which permits the passage of small steamers unloaded. This is called "steamboat low water," and is one foot above the ordinary low water of summer. From the mouth of the river to Nashville navigation is practically at from one foot to one and a half feet above low water; above that, on account of numerous and long shoals, from four to eight feet are necessary. All told five to six months of navigation, mostly in winter and early spring, are possible without the aid of locks. The great uncertainty of navigation on the upper Cumberland made the stream of uncertain value as an outlet for the eastern counties of the Pennyroyal. During Jackson's administration, and through his influence, about $90,0000 were appropriated and expended in the construction of riprap dams,[2] some of which are still maintained, and in deepening the channel of the stream. These improvements afforded slightly deeper water through the shoals. During the whole of the steamboat period of American history the Cumberland was essentially unimproved, and its use was attended by great difficulties and by long, seasonal interruptions.

The only effective local improvement in river navigation during the steamboat period was on the Green and Barren rivers, major outlets of the central Pennyroyal. Laws were passed from 1808 on relative to improvement of their channels. Between 1833 and 1836 $215,500.00 were expended in surveys and improvements, much more than was applied to all the other rivers of the state. The first lock and dam was built in 1834. The

[1] For an account of the original condition of the river, see Killebrow and Safford, Resources of Tennessee (1870), pp. 286-298.
[2] Ibid., p. 304.

project of slack water navigation, extending 180 miles on the two rivers to Bowling Green, was completed in 1843, at a cost to the state of nearly a million dollars. From 1843 to 1865 there were occasional dividends to the state from this waterway, but it was not self-supporting.[3] It was however a most important trunk line at this period.

Surveys were made for the improvement of the South Fork of the Cumberland, Rockcastle, upper Big Barren, Salt, and Little rivers and of canals to connect them. The Little River survey for example contemplated the connection of Hopkinsville by canal and dredged stream with the Cumberland. None of these projects was carried out.

The need for improved roads during the steamboat period was solved by macadam surfaces, for which the area possessed limestone in wide distribution and of high binding quality. The cost of these hard surfaced roads even at that time was high and for first-class construction and a width of macadam surface of a rod or more amounted to at least five thousand dollars a mile. Failing in national aid, the state began to make road appropriations from 1830 on to aid turnpike construction. Incorporated road companies received such subventions and toll roads were constructed as rapidly as local capital could be secured.[4] Of the roads built in this manner the most important ones in the Pennyroyal were (1) the Louisville-Nashville Pike, passing through Bardstown, Glasgow and Scottsville, now the Jackson Highway, and (2) the pike from Louisville through Elizabethtown, Bell's Tavern, and Bowling Green to Nashville. The latter is now the West Dixie Highway as far as Bowling Green. The road continued south through Franklin and is still known as the "Old State Road." The state contributed nearly a million dollars towards the building of these two turnpikes.

Other turnpikes were built for short distances out of Hopkinsville, Cadiz, and other market towns. The total mileage of these pikes was not great, though they appear to have been pretty numerous.

[3] Collins, loc. cit., vol. 1, pp. 544-545.
[4] Collins, loc. cit., vol. 1, pp. 539-41.

Railroad building did not commence until the late 50's, or until the good farm lands of the Pennyroyal were well improved, the market towns established, and the major lines of communication fully determined. The railroads caused no revolutionary

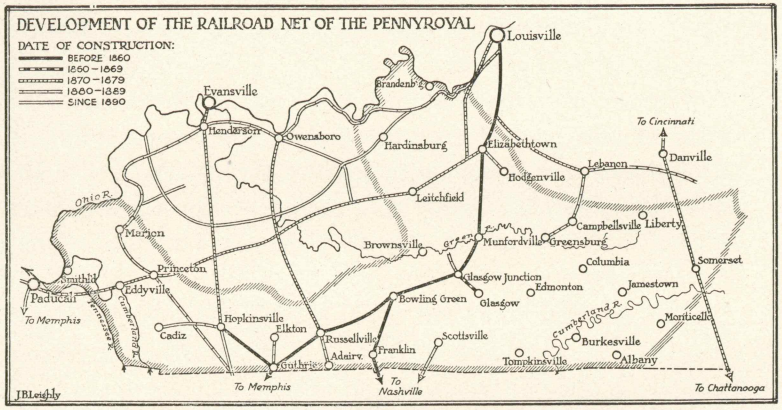


FIG. 111. DEVELOPMENT OF THE RAILROAD NET OF THE PENNYROYAL.

change in the general character and direction of commerce nor in the location of commercial centers. The inland location of the more productive districts, their continuity, and smooth surface made railway construction advantageous and relatively inexpensive. The corridor character of the region attained to its full effectiveness by the building of trunk railways between the Ohio River and Nashville. Those centers which were not placed on a through rail route then usually secured branch line connections. Usually the railroads passed through the outskirts of the towns.

Thus the main line of the Louisville and Nashville Railroad chose the more westerly course along the inner margin of the Pennyroyal Plain. This line was completed in 1859. The Memphis division was opened the following year, making Bowling Green the first railroad junction in this part of the state. Almost mile for mile these two original main lines of the railroad outline faithfully the old wagon routes between the Falls of the Ohio at the north and the bend of the Cumberland and the Chickasaw Bluffs at the south. The more easterly route north and south through Glasgow was not followed by a rail route, we may suppose because it encountered a more rolling country and though possibly a shorter connection between Louisville and Nashville, would have lengthened the rail route to Memphis. A railroad over the eastern or "Jackson Highway" route was projected and was graded as far north as Glasgow but the only part actually put into service was the branch from Nashville to Scottsville (Figure 111). Hopkinsville was connected by rail with Guthrie prior to the Civil War, the first branch rail line of the Pennyroyal.

Glasgow built a branch line after the war, in 1869, to connect with the main Louisville and Nashville line. The decade 1870-79 saw the construction of most of the other through lines affecting the Pennyroyal. The Louisville and Nashville Railroad finished its second outlet to the Ohio, the line from Henderson to connect with Hopkinsville, Guthrie, and Nashville, in 1871. This is now a main line from Chicago to the South. Russellville, then still one of the dominant towns of the Pennyroyal, secured rail contact with the Ohio River at Owensboro shortly after, really the first longer line built as the result of local transportation needs. This road failed and was sold by foreclosure in 1876, passing first into the hands of the Nashville, Chattanooga, and St. Louis Railway and finally to the Louisville and Nashville Railroad. The railroad from Louisville through the Western Coal Basin to Paducah was opened in 1872 and was operated as part of the Chesapeake and Ohio Railway for a time, giving a second main route between Louisville and Memphis.

The period 1880 to 1889 saw the building of subordinate through lines along the Ohio River and of short branch lines in the southern and central portions of the Pennyroyal. Since then only minor additions have been made to the railroad net, no railway lines having been added since 1902. All of the most important present rail lines of the region were in operation by 1872.[5]

While railways were being built, agitation continued for the improvement of waterways. On Green River, the locks and dams that had been built by the state were taken over by the Federal Government in 1888. They were in bad repair at the

[5] For historical data see Poor's Manual of Railroads, especially the issues of 1888, 1885 and 1884.

time and were rebuilt, with the addition of two new locks, that extended navigation to Mammoth Cave on the Green and to Bowling Green on the Barren River, giving a five-foot channel throughout the year. The importance of this improvement is

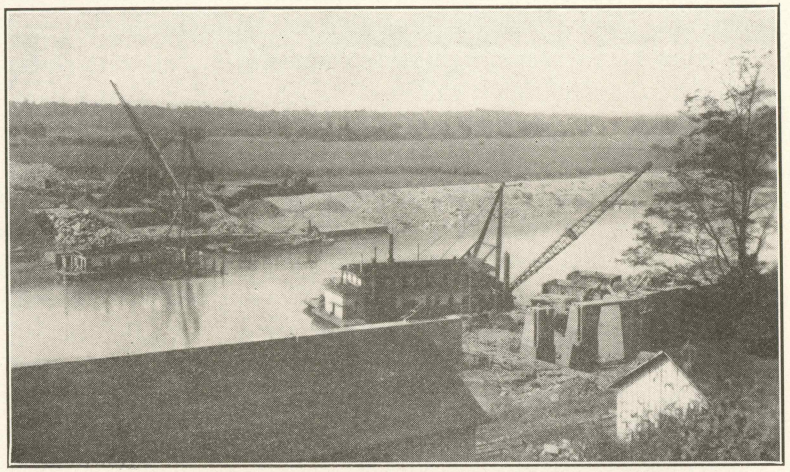


FIG. 112. NEW FEDERAL LOCK, EDDYVILLE.

Construction of the lowest and last lock on the lower Cumberland River, Eddyville, 1923. Slack water navigation for boats of the usual draft of Mississippi River steamers is now provided for the lower Cumberland and most of the Nashville Basin.

found especially in the fact that it gives shipping facilities to a stretch of rugged country north and northeast of Bowling Green, the second-largest area in the western half of the state without rail connections.

On the Cumberland a project of slack-water navigation was adopted in 1892,[6] the principal improvement being made in the vicinity of Nashville. The lower river is at present being regulated so that it will allow of adequate navigation during low water. A lock and dam are under construction at Eddyville (Figure 112), and a dam (Number 52) on the Ohio River, which will give continuous navigation at all seasons from the mouth to Nashville. Seven dams were built above Nashville between 1904 and 1910, their benefits however not extending upstream to the Kentucky line. In 1911, a dam was completed 26 miles below Burnside, enabling navigation at all seasons down stream

[6] Dept. Chief of Engineers, U. S. Army (1923), Pt. 1, p. 1159.

for that distance from this rail point. The intervening stretch includes four river counties without river improvement and without railroad. In this general section lie eight counties without any rail lines or the prospect of rail facilities, the largest

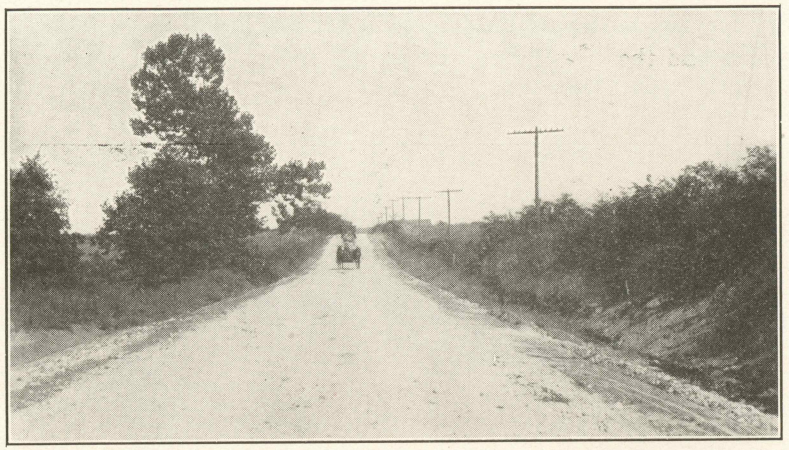


FIG. 113. NEW "PIKE" BETWEEN CADIZ AND HOPKINSVILLE.

The road is surfaced with gravel brought in from upland deposits in the Interfluve Area, this material being cheaper than local crushed limestone, formerly used on macadam roads of the Pennyroyal Plain.

and most populous area in the state in such condition. The completion of the improvement of the Cumberland is a matter of vital concern to the economic life of this area.

Road Pattern and Road Forms

In the Pennyroyal Plain roads are hardly diverted at all by obstacles of surface. With reference to market towns the roads have a strikingly radial arrangement. The most important roads are usually nearly straight, partly because they were laid out prior to the establishment of farm boundaries and partly because having been toll pikes, they were built with due regard for economy of distance (Figure 113). Lesser roads show numerous minor angular irregularities, ususally determined by boundary lines of farms. In the cavernous limestone country bridges and fords are very few and far between. Near the streams, where the surface is abundantly pitted with sinks, the greater irregularity

of road pattern is due to this condition rather than to ridge and valley spurs.

In the other areas, excepting most of the Elizabethtown Area, dissection of surface determines location of roads. They are for the most part on ridges, in certain localities on valley floors, and the crossing of valleys and their streams is a major problem of transportation.

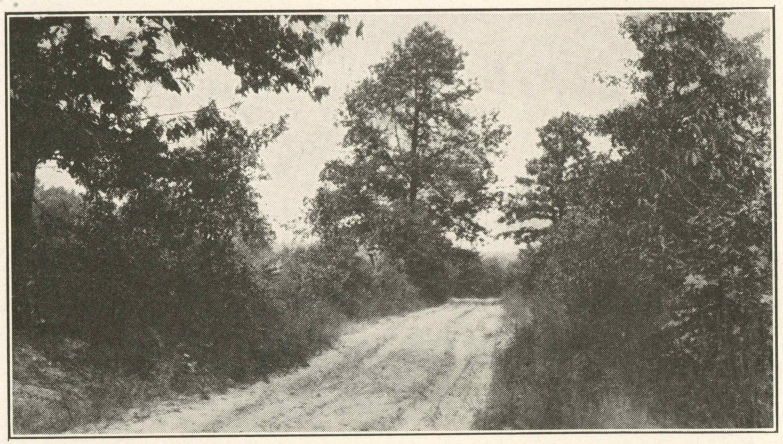


FIG. 114. RIDGE-TOP ROAD, GREENSBURG AREA.

This being one of the highest and most northerly ridges the material is sandy waste from the Coal Measures and therefore passable in wet weather.

In the Interfluve Area the terraces of the rivers form good road-sites, but they are rarely continuous for more than a few miles. The upland is much dissected and the watershed between the rivers does not furnish a continuous, smooth-topped ridge. Roads hence must climb from valley to ridge, to descend again shortly. The area is crossed by several trunk roads but for the most part the farm roads seek near-by river landings and are short.

In the Clifty areas the ascent to the escarpment involves heavy grades, reduced in places by using a reentrant valley as approach. The passage from this area into the Coal Basin is made along narrow and crooked ridges or down deeply intrenched valleys. Extensive cuts and fills and numerous fords

and bridges are common. The less used roads may have dangerously steep grades and crooked courses.

The Greensburg Area has for the most part a simple ridgetop road system, dictated by smoothness, drainage, and location

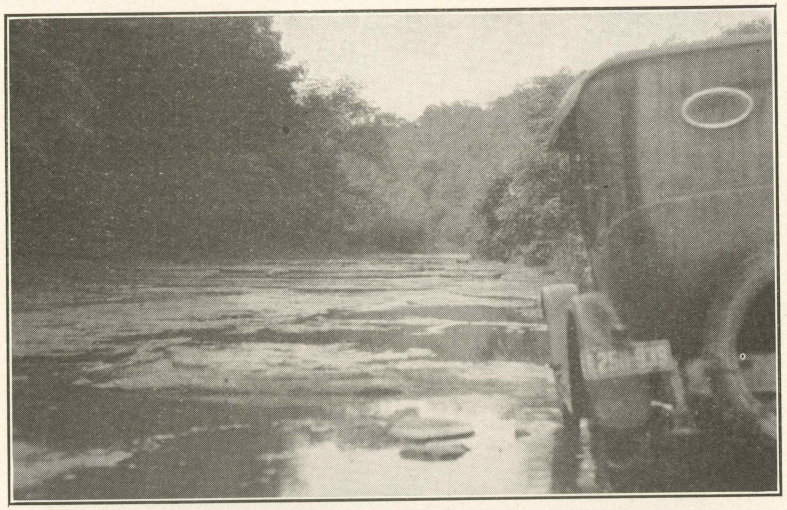


FIG. 115. CREEK BOTTOM ROAD IN GREENSBURG AREA.

The thin-bedded limestones form a fairly smooth surface with reasonably good traction when the later is low.

of farms. The length of the valleys, however, makes lateral connections across the valleys necessary, usually by means of steeply descending and often badly washed roads. The creek settlements have roads reminiscent of the Mountains, following commonly the creek bed, here in large part rock-floored, but leaving it at intervals to pass through a farmstead. The latter roads are, of course, much subject to interruption of traffic by freshets. The two types of roads are shown in figures 114 and 115.

In the Mountain Margin the major locus of roads is the limestone piedmont. The river "breaks" have roads of the ridge-and-valley type in their most extreme form. The Cumberland bottoms have in general one main road, ascending the slip-off slope and leading back through the dissected belt to the main ridgetop. On the side opposite the bottom there is found, in some cases, a creek-bottom road that ascends by way of a headwater to the upland.

The vast majority of the roads are unimproved "dirt" roads. Both soil and sub-soil contain in most sections a large proportion of clay. Very few of the dirt roads can be used for hauling loads, except in dry weather. Those located on narrow

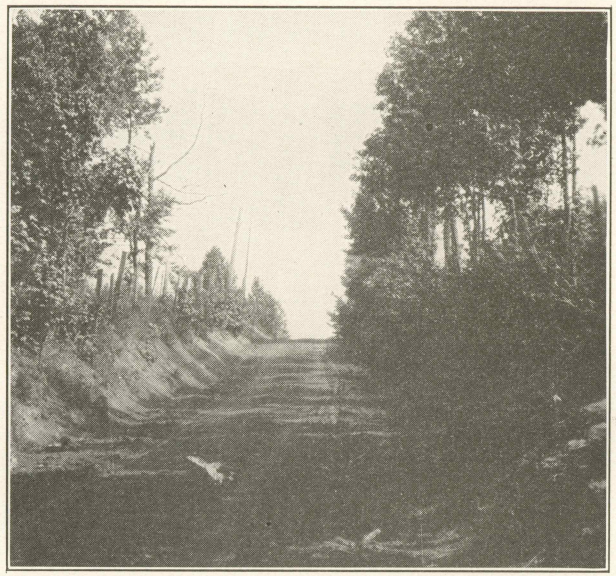


FIG. 116. RIDGE-SLOPE ROAD IN CUMBERLAND COUNTY.

The deeply weathered soil and subsoil is gradually being removed by wheel traffic but the road has not yet begun to wash. Roads of this sort are characteristic of the cavernous limestone, shaly limestone, and loess slopes where travel is not heavy or where the roads have not been in use long.

ridgetops and therefore well drained are in part an exception. On drying, hard, deep ruts form that require a subsequent period of breaking in before hauling again becomes normal. On the upland the dirt roads are essentially at the level of the surface in general, except in the loess areas where they have been worn down, often many feet, below the general level. On slopes, however, they are severely subject to erosion. Where weathered material is thick on slopes the country roads are commonly sunk to a depth of several feet below the general surface (Figure 116). Innocent of ditches, after rains they are a mass of slowly drying mud. In time the road wears through the soil and sub-soil and

rock ledges appear. Successive stages of destruction of roads are shown in figures 117, 118, and 119.

The improvement of the local roads has been determined for the most part by the needs of wagon haulage rather than by

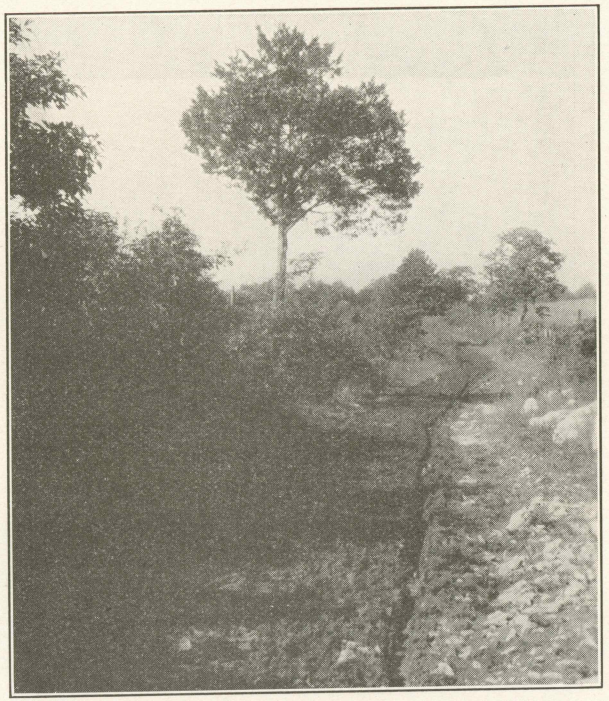


FIG. 117. SLOPE ROAD GLASGOW JUNCTION SECTION.

Here a mantle of waste, originally less thick than in Fig. 116, has been cut through by traffic, and the glady limestones exposed. The road has shifted laterally, to the left, to avoid the rough exposed surfaces of limestone.

automobile travel. Short, steep grades and sharp turns, therefore, have not been eliminated from these roads as will be the case when they are redesigned to meet the demands of automible transportation. The simplest way to get rid of mud is to throw field stones into mud holes. This type of hard surfacing breaks the monotony of travel on many otherwise unimproved roads. Mostly, improvement has been by macadam, broken limestone, usually from the cavernous beds. In places this has been mixed with chert to add resistance to wear. In most parts of the Mam-

moth Cave limestone outcrops good road metal is easily available, requiring, however, to be broken on rock piles or crushed in machines. The Waverly areas rely for the most part on stream gravels, largely chert fragments with minor admixture of

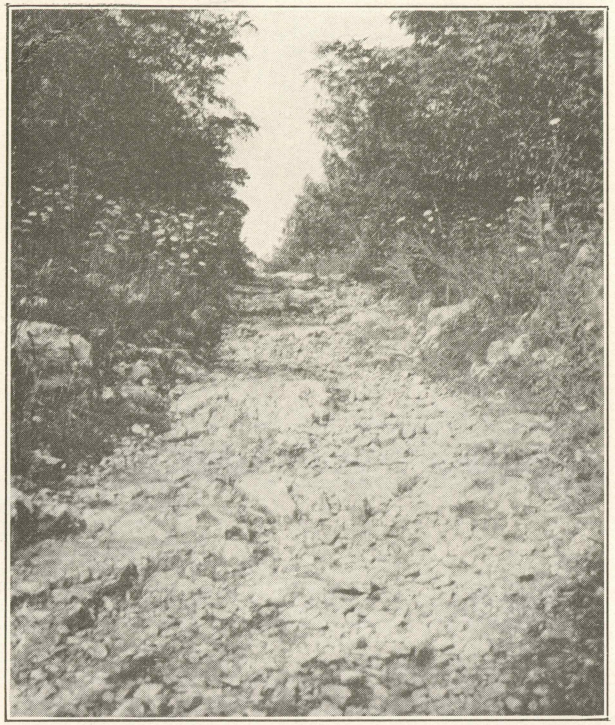


FIG. 118. THIS IS IN SAME LOCALITY AS FIGURE 117.

The soil cushion has been entirely washed away, the road being a mass of limestone fragments and ledges.

limestone. This makes a cheaper road surface than broken stone. Its disadvantages are that the gravel is likely to be of uneven size, ordinarily is not screened, is found in small bars, which are soon worked out and require a pretty continuous search for accessible road metal and if often too round to pack well.

The Interfluve Area has the best supply of road metal in the Pennyroyal and also the best common road system. The ample deposits of ancient gravels (Figure 120) form permanent road beds almost without improvement. They also yield a

cheap and excellent export material to the western part of the limestone plain, where it is largely used on pikes (Figure 113) in preference to the much more costly crushed rock.

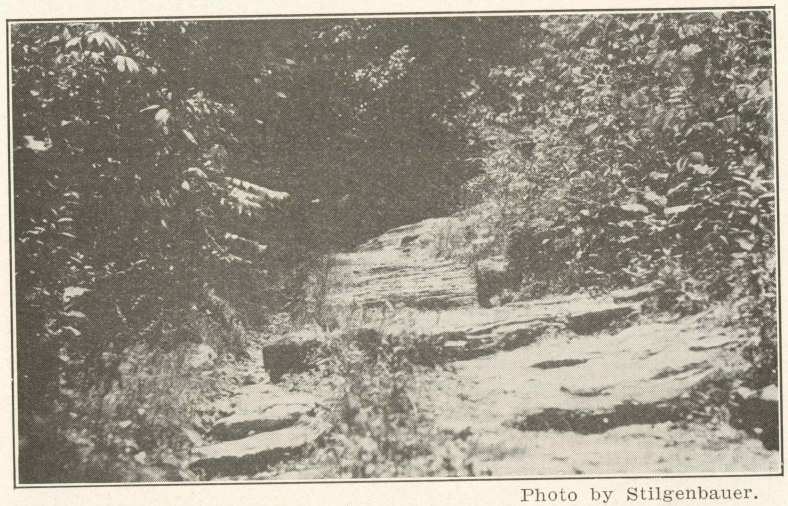


Photo by Stilgenbauer.

FIG. 119. OLD COUNTY HIGHWAY ON WHITE OAK CREEK.

This trail is still nominally in use. At the middle crossing of the creek, the steep grade, in use probably for a century has been washed to such an extend that only a series of rock ledges remain.

The best of all local road-building materials is the sandstone of the Clifty Area that has become impregnated with asphalt. This so-called Kentucky Rock Asphalt is especially abundant in the country adjacent to Green River and is shipped out in increasing amount to be used in city paving and major highway construction. It has been used locally in Bowling Green and in short stretches on the Dixie Highway, but for the most part is too expensive for present local demands.

The Areal Conditions of Transportation

The present facilities of transportation are shown in Figure 121. The railroad net of the Pennyroyal has been almost unchanged for a generation (See Figure 111). The system of state highways is blocked out in project though much construction remains to be done. The improvement of waterways has as the one remaining major task the locking of the Cumberland above

the Tennessee line. The present and prospective lines of communication are therefore adequately indicated on the map here reproduced. The areal inequalities in kind and quality of means of transportation are obvious and provide the basis for dividing the Pennyroyal into sections conditioned by their respective transportation systems.

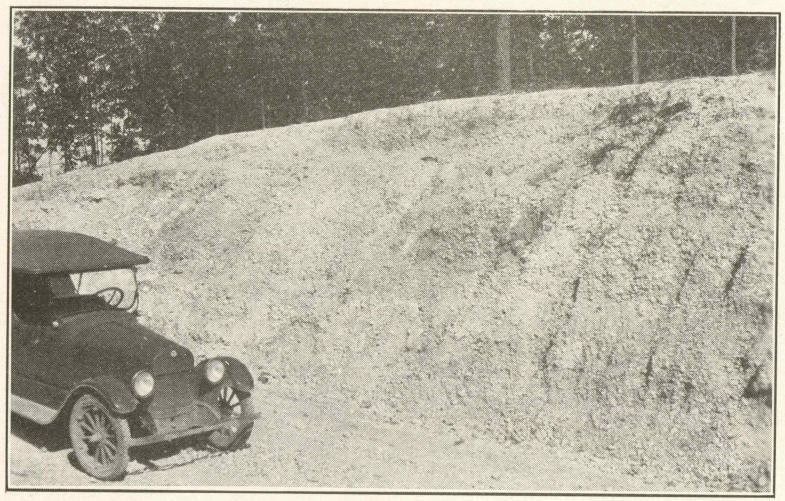


FIG. 120. ROAD MATERIAL IN ABUNDANCE.

North of Grand Rivers, cut in Interfluve Area, showing the characteristic road-side gravel deposits which facilitate local road maintenance.

The Major Corridor: The Pennyroyal Plain, the Elizabethtown Area, the fault-block country in part, and the southwestern margin of the Greensburg Area form one major transportation region, characterized by through rail and highway routes, and by sufficient branch rail routes. This area forms a narrow crescent, with its two extremities touching the Ohio River. The north-south trunk rail lines of the Louisville and Nashville Railroad are parts of one of the most important through routes of the South, and constitute the major arteries of communication of the Pennyroyal as a whole. From Chicago, Detroit, Cleveland and St. Louis major train service is maintained through this area via Louisville and Evansville to Florida, Mobile, New Orleans and Memphis. The improvement of highways parallel to these rail

lines is proceeding steadily and they may soon rival the railway lines in importance. Should the oft-projected consolidation of Illinois Central and Tennessee Central railways take place the western part of the corridor would have still another main line Chicago-Paducah-Hopkinsville-Nashville.

In the area described there are more than fifteen hundred miles of stone roads, mostly built as toll roads, but since taken over in virtually all cases by the counties. When first built, these were excellent roads and were entirely adequate for the conditions existing prior to the great growth of automobile traffic. Under usage by automobiles they quickly become rutted and rough. Many of the main travelled roads are now badly worn out, but in most sections no more durable road has come to replace the old macadam surface. From the view-point of the farmer the condition of these roads is not especially objectionable. The stone foundation still makes it possible for him to haul his produce over the turnpikes at all seasons. The roughness of the surface at most means slightly reduced loads.

In general the area has transportation conditions adequate for its hauling needs though most of the roads are sadly deficient for pleasure driving. The chief commercial commodity is tobacco, which can be taken to the rail points in general without difficulty. Next in importance are beef cattle and hogs, which again are not exacting of transportation facilities. In the few sections in which the dairy industry is important the best local roads are found. Very little bulky farm produce, such as hay, grain or other feed, is hauled for any great distance. In the earlier days the difficulties of transportation were so great that only goods such as tobacco and live-stock could be shipped out. As better means of transportation were provided the economic system suffered little change. It is likely that the historic system of farm production, with its tolerance of indifferent roads, has been somewhat of a check to the building of better local lines of transportation.

Water transportation is not very important in this area. In the western part the Cumberland River is used locally, but the condition of the river at low water has made rail shipments more important than river-borne freight even in that section.

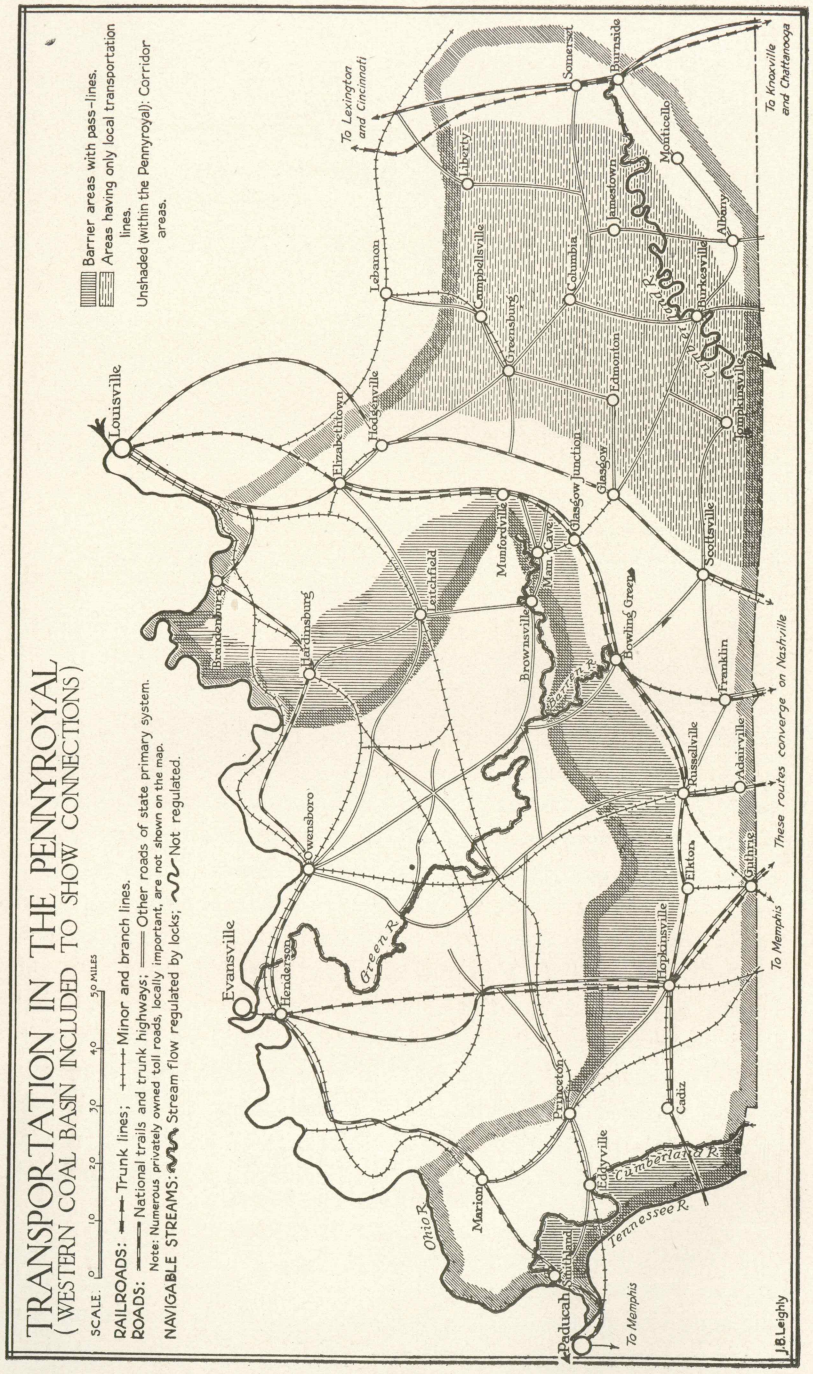


FIG. 121. TRANSPORTATION IN THE PENNYROYAL AND WESTERN COAL FIELD.

The improvements now under way on this river may alter the situation somewhat, though this improvement does not appear likely to have any major bearing on local production and movement of freight. The navigation of Barren River has been increasing in significance lately, principally in connection with the shipment of rock asphalt and the oil business, Bowling Green being the chief beneficiary in the handling of both groups of commodities.

The Mountain Margin: The belt of smooth land at the base of the Mountains is a secondary corridor, containing short stretches of two trunk railway lines between the Bluegrass and the Valley of East Tennessee. Parallel highways are in process of improvement. In addition the area has an old, partially improved road that is tangential to the Mountain front, running from Mt. Vernon through Somerset, Monticello, and Albany into Tennessee, where it passes through the Highland Rim into the Nashville Basin. This road traverses in large part a country remote from railroad lines. A railway was once projected and in part graded along a portion of this route, but the project is not likely to be revived. From this main road many minor roads lead back into the Mountains and down to the Cumberland River. Over it goods are hauled to and from remote points by covered wagons reminiscent of the prairie schooner and by light trucks when road conditions permit. The building of a permanent road along this course is one of the major desiderata in the improvement of transportation in Southern Kentucky.

The Interfluve Area: This dissected area is crossed by one railroad and by two major wagon roads. None of these routes have any great significance to the area, which finds its market largely through river boats plying out of Paducah. Livestock and ties, the principal products of the area, are provided for adequately by these means of transportation. Each small section has its landing on one of the rivers, distance of land haul being limited to a very few miles. The gravel substratum makes the ordinary country roads superior to those of other sections of the Pennyroyal. As a transportation area this section might well be considered as a marginal area of the Ohio-Mississippi confluence, or a dependency of Paducah and Cairo.

The Marion Area: The northern part of the fault-block country suffers from serious transportation difficulties. The Illinois Central Railroad provides by means of a branch line the major outlet. The confused surface makes impossible the location of long stretches of road on ridgetops. The loess-beds of the roads are subject to serious washing and become very muddy after rains. As far as the local livestock industry is concerned these handicaps are not serious. The area has however extensive fluorspar deposits, a bulky commodity of low value. The use of motor trucks is practically out of question for most of the roads. The development of mines has therefore been restricted in part to sites convenient to railroad or river. The other mines haul by mule team when they can get out with their product, the roads being used until they are cut up so as to become impassable until the next period of dry weather.

The Clifty Areas: Fortunately for the Clifty Upland the most important lines of communication of west-central Kentucky lie parallel to the sandstone escarpment on the adjacent limestone plain, and the chief towns of the Pennyroyal are situated at or near the base of the escarpment. The area has therefore short distances to good outlets and is moreover crossed by railroads and roads leading north from the limestone plain to the Ohio River. Like the Interfluve Area therefore it is a region of transverse roads. Most of the lines follow down valleys on either slope at points where the highland is most constructed. In the Northern Clifty Area smooth upland surfaces have enabled the spreading out of a road net to some extent. In the more dissected regions those roads that are not being maintained by the state as through routes are probably as bad as anywhere in the Pennyroyal. In the central part the navigable waters of the Green provide an outlet for a very rugged section.

The Greensburg Area and the Cumberland Enclave: Eight counties have no railroad. No rail line penetrates the Cumberland Enclave and none crosses the Greensburg Area. Three enter its western margin, making Scottsville, Glasgow, and Greensburg-Campbellsville important rail heads. No improved wagon highway crosses the area, in wet weather the more eastern counties being virtually cut off. There are in all about three

hundred miles of turnpike, mostly disconnected stretches about county towns, in part toll roads, and some of them in poor repair. They are at best all-weather haul roads, not touring roads.

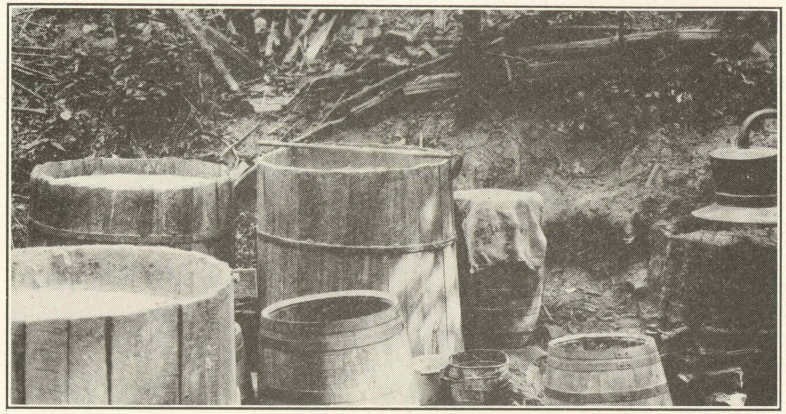


FIG. 122. UNDISCOVERED.
Mash vats and moonshine still in the Greensburg Area. Such stills are most commonly located in small coves, screened by timber, remote from unannounced visitors, and convenient to spring water.

The expectations of through rail connections are dead these forty years. It was not topography that caused the gap between Scottsville and Greensburg to remain. The area did not have the local resources to urge the completion of a railroad across this hilly belt. Through transportation was provided by the Louisville and Nashville main line to the west, and the second line has not been needed, or at least has been frustrated by the passage of the two branch lines under the control of the Louisville & Nashville system.

Road building, to the extent of making gravel surfaced roads and of reducing grades at stream crossings, is proceeding slowly. Half of the pikes, or surfaced roads, are probably to be found in the counties of Adair and Taylor. The Burkesville oil fields have stimulated the building of a road out of the Cumberland bottoms toward Glasgow, still in such condition however that cars engaged in taxi service wear out in about eight months. In large part the state primary road system represents as yet merely a project on paper, in so far as it applies

to this area. For parts of this area commerce is almost non-existent and it is not known to what extent a commercial economic system could be developed. Whether the rather high frequency of moonshine stills (Figure 122) is an expression of commercial isolation and would be reduced by better roads may remain an open question.

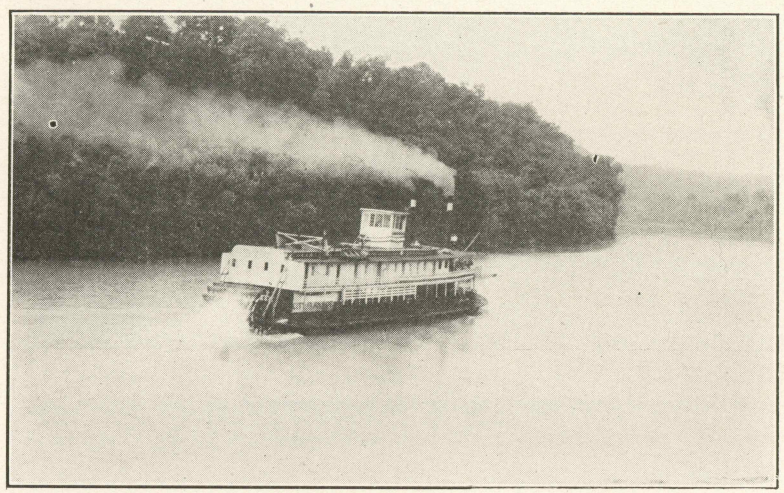


Photo by Stilgenbauer.

FIG. 123. PACKET "CITY OF BURNSIDE."

This boat handles most of the traffic below Burnside and above the upper lock during the summer season. In winter a number of packets are in service.

At the west the area finds an outlet to the rail-head points mentioned. At the northeast stations on the Queen and Crescent Railroad take care of the trade that finds its way out from points as far interior as the margins of Adair County. At the south and southeast the principal outlet is the Cumberland River, for which Burnside is the chief shipping point. Packets (Figure 123) ply down stream to the one existing lock as business demands. Since the stretch is only a little more than a score of miles the packet service is determined largely by the availability of transfer goods at the lock. The large boats take down stream such supplies as the country stores need and oil drilling and production supplies. Such freight as is to go beyond the lock is ordinarily transhipped at the latter place to gasoline boats of the type shown in Figure 124.

The gasoline boats are of very light draft and low speed, paddle boats which operate precariously and irregularly on the unimproved river. They are of cheap construction, ordinarily manned by a crew of two or three, and carry their freight mostly on small barges. These barges are pushed ahead of the boat

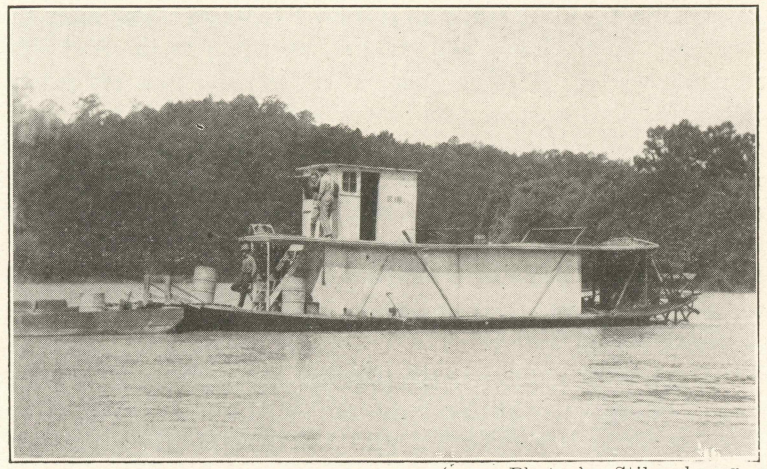


Photo by Stilgenbauer.

FIG. 124. SHALLOW RIVER PACKET.

Type of small gasoline boat and barge used on river in its unimproved portion.

which thus keeps it stern free for manoeuvring through the tortuous shoals of low water. In going down stream poles are freely used to keep the boats clear of the bank on sharp turns in rapid water. It is more particularly upstream navigation that brings out the ingenious simplicity of this transportation unit. The shoals are numerous and troublesome during the summer season. Light loads only are handled upstream therefore and are distributed over boat and barges so as to keep the vessels at minimum draft. Low speed engines are used because high speed engines will throw the water out from under the boat so rapidly as to seat it on the shoals.

Summer navigation is limited by the feasibility of propelling such boats upstream through the shoals. The boat enters a shoal, gaining foot by foot against the rapid water, the course remains unchanged so long as it is gaining. If it starts to lose ground the boat is swung into quieter water on the inside of the

bend or channel if depth of water permits. Poles are brought into use and the crew aids the laboring engine to make headway against the current. If a capstan is available a line may be thrown about a tree trunk upstream and the boat is hauled up through the swift water in this fashion. Otherwise the crew may take out a line and attempt to tow the boat. If all these devices fail the boat may tie up below the shoal, watching the stage and water closely and starting up again at the first sign of rising water. If there comes a "tide," as floods are locally called, the low-powered boats work their way against the current by choosing the quieter water on the inside of bends, hard against the fringe of trees that marks the river bank, or going over the flooded cornfields behind them. When such a boat crosses the river in flood it loses headway. Thus to come up a flooding stream, crossing occasionally from one sheltered "backwater" to another is arduous work, for these boats are not made to "buck" flood-waters.

Flood season is rather the time for the large packets, which run down stream with the mountain flood waters, gauging the distance of their commercial raid nicely with the size of the flood and rarely being caught by an unexpected fall of water. During winter and spring the entire river is open to the large boats and then the river settlements get the major part of their supplies in and move their surplus products out.

Transportation Problems

The eastern part of the area has the most pressing transportation problems. The Mountain Margin should see within a few years the reconstruction of its old piedmont route as major artery of wagon and automobile transportation for an otherwise inaccessible country. The project of improvement of the Cumberland River is only in small measure competitive with this road. The Cumberland Valley communities can scarcely expect sufficiently numerous and sufficiently well engineered roads to enable them to overcome the hill barrier about them by road hauls. Here, if anywhere in the United States, is a real need for improvement of river transportation. If this is realized a fair share of the heavy freight of the Mountain Margin and the eastern Greensburg Area, such as lumber and ties, may be expected to move down grade to river points. The development

of the state primary road system does not contemplate important trunk routes through the Greensburg Area, excepting along its western margin. State aid however appears to be necessary if these poorly equipped counties are to have proper communications.

The western half of the Pennyroyal is not strikingly backward in its lines of communication. Comfortable automobile roads are still largely lacking and the progress made in other sections of Tennessee and Kentucky makes therefore an unfavorable impression on the automobile tourist. The area however has the means to move its commerce and the wealth and position to expect shortly major touring highways in number. It is only a question of a short time until such roads as the Dixie Highway, the Jackson Highway, the Dixie Bee Line, and the Jeff Davis Route will satisfy the exacting traveler and be conducive to pleasure riding by local people. These roads are expressions of the great corridor which the cavernous limestones form and they will be taken care of by interests much broader than those of the locality.

The future is not likely to see much change in the age-old contrast between the east and west of the Pennyroyal; here highways between the north and south and there "back" settlements, away from main-beaten trails.

CHAPTER THIRTEEN

THE CULTURAL LANDSCAPE OF TOWN AND VILLAGE

Court and Market Places

The Pennyroyal is rural. In 1830 about five per cent of the population lived in towns and villages. At present perhaps one person in six lives in town. There have been few incentives for the establishment of urban centers except as these have been needed by the agricultural population. Industrial centers are wanting and industry is restricted to a few types of manufacturing that have grown up in intimate association with the trade of the more important centers.

Each town is to be understood therefore primarily in terms of its agricultural hinterland. Size and quality of tributary farming area on the one hand and facilities of communication on the other form the known determinants of growth of most of the centers. Superior accessibility may make up for inferior productivity and produce thriving towns in a country-side that is not particularly thriving. In general, however, size, prosperity, and spacing of towns are intimately related to quality of land.

The earliest factor in determining the site of towns was political rather than commercial. The first generation of settlers had little to buy or to sell other than livestock. Stock was driven out without great difficulty from all parts of the region, and stock raising did not result in the development of commercial arteries. There were of course the pioneer highways, repeatedly referred to, but these served as lines of movement of people rather than of goods in the earlier years. It was hardly because heavier cargoes of freight could be handled over these routes than elsewhere that population at first concentrated along them but rather because they were short lines between far-extended settlements and because of their relation to water and wood that the settlements were most numerous along lines, such as the base of the Clifty escarpment.

The establishment of the first towns followed closely upon the organization of counties, or in some cases, preceded slightly political organization. In other words, town building begins with the last decade of the eighteenth century. The settlements were at first along the margin of woods and grassland at points of

convenient ingress from the Bluegrass or Nashville Basin (see chapter eight). They were therefore detached bodies of population that soon felt the need of political organization. As a county was organized it became necessary to fix upon a county seat. The county seat was usually placed in a central position with reference to the area it was to serve, which was the area of settlement, not the whole of the area politically assigned to the county. Thus the three oldest counties, Logan, Hardin and Green placed their county seats in the midst of the original community about 1790. As the region became subdivided into smaller and smaller political units, the number of political centers increased, and with their political function they almost invariably developed commercial leadership. All but eight counties were organized by 1820, or prior to the commercial development of the area. The principal centers of population therefore were fixed by this time by political act of their constituencies.

Christian County was formed in 1796 from Logan County. At the first meeting of the county court a committee was appointed to select a site for the county seat. There was at this time no village of any sort in the new county. The site of Hopkinsville was chosen because of its central and convenient location within the string of settlements that extended along the base of the escarpment and because a citizen offered "five acres of land for public buildings, timber for building the same, and half of the spring" that later served the town.[1] "The moving cause of Todd's origin is not far to seek. The early form of concentrated government made the presence of a large number of its citizens at the seat of justice a necessity, and social traditions more potent than law made it a pleasure to a still greater number. The character of the country and the meagre internal improvements, made these long pilgrimages a frequent source of irritation and ripened a vigorous and influential demand for home government."[2]. A number of central points were considered, the final choice at Elkton being on a tract of land donated for that purpose.

In Trigg County the committee appointed reported: "After a mature and deliberate examination of many places proposed as sites for the administration of justice at and near the center of said county, we are of the opinion that the seat of justice should be fixed upon the lands of Robert Baker where he now lives on main Little River on top of the eminence above the spring, at or to include the lot wherein his stable now stands, it being the most central, convenient and eligible site for the purpose. Whereon the said Robert Baker has this day obligated himself to convey to the said county of Trigg, for the use of the county, together with fifty acres more to be laid off at right angles from the squares of said public square."[3] Once thus centrally established the county seat received official aid in developing as the chief center by the laying out of roads through court action radiating out from the court town.[4]

[1] (History of) Counties of Todd and Christian, Kentucky; sec. on Christian, p. 51.
[2] Ibid., sec. on Todd Co., p. 21.

The circumstances attendant upon the location of nuclei of settlement, as set forth in chapter eight, were therefore dominant in fixing the town sites, the latter being simply central to the larger pioneer community. As commercial interests developed, these early political and social centers were able in almost all cases to develop also as adequate market centers. The courthouse square is a most striking feature of all such towns. Within it stand the county buildings. About it, often on all four sides, are grouped the main business structures. When railroad transportation later became important, the business district commonly extended from the courthouse square toward the rail station. This is however ordinarily a secondary business street. The marginal location of the railroad has resulted in some cases merely in the development of warehouses, lumber and coal yards about the railway.

The Towns During the Earlier Commercial Period

Commercial development locally dates from about 1820, when tobacco culture and steamboat transportation commenced seriously to displace the pioneer economy. The Cumberland River then became much more significant than it had been before. Roundabout though its course was and interrupted by shallows, goods could be floated out over it to the Ohio and to New Orleans. The towns however for the most part were not on navigable

[3] (History of) Counties of Christian and Trigg, Kentucky; sec. on Trigg Co., pp. 19 and 20.
[4] Ibid., p. 21.

rivers, Burkesville, Brandenburg, and Smithland being the principal early exceptions.

Landings, convenient to the principal producing areas were thereupon connected by pikes with the older centers and their growth was stimulated. One of the most interesting cases, typical of the general situation of the time, was that of Canton, in Trigg County, first known as Boyd's Landing. "Up to the completion of the railroad to Hopkinsville more freight was received and more tobacco shipped here than at any point on the Cumberland River, with the exception of Clarksville (Tennessee), from Burkesville to the mouth. The first road that was opened from the place was before the village was laid out, and is still known as Old Boyd's Landing road, leading to Hopkinsville. In the year 1823 the village was regularly laid out. Several business men came to the town shortly after it was laid out, and its importance as a trading point continued to grow. A number of warehouses have been built at different times" The Canton and Hopkinsville road was established by act of legislature in 1819 or 1820, and for many years was the principal stage and mail route for Trigg and Christian counties. "Prior to 1860 Canton was the distributing point for a large territory, and on this road could be seen, almost any day, lines of freight wagons, extending a mile or more in length."[5] Then railroad building first detached the Hopkinsville territory and later Cadiz and its producing country. Although a busy shipping point, controlling the best single area in the whole Pennyroyal, Canton never was a town of important size or of much merchandising. Here as elsewhere in the region river trade affected road building but was not able to interfere seriously with the growth or rank of the older inland towns.

In 1830 the principal towns were as follows (population for 1920 in parenthesis):

Russellville	1,358	(3124)
Hopkinsville	1,263	(9696)
Bowling Green	815	(9638)
Greensburg	669	(488)
Glasgow	617	(2559)
Elizabethtown	601	(2530)
Columbia	422	(1076)
Smithland	388	(559)
Princeton	366	(3689)

[5] History of Trigg Co. (1884), pp. 112-113.

Elkton	382	(1009)
Burkesville	340	(798)
Brandenburg	331	(503)
Hardinsburg	316	(810)

All of these towns were county seats. The most notable difference in relative importance of these places as between 1830 and the present is that the four towns that have lagged most are all river towns. Greensburg has fewer people today than it had a century ago, a condition possibly not true of any other town in the Pennyroyal. Greensburg was one of the original towns of the region and owed its early importance in part to the precarious commerce that was carried on the Green River, in part to the old land route that led from there back to the Bluegrass, in part to the early tobacco industry on its forest soils. The attractions for agriculture of its territory were reduced as farming shifted more and more to the Barrens, its commercial significance was largely lost as railways were built. Smithland, Burkesville, and Brandenburg were also relatively more significant a century ago than at present, their tributary areas then being relatively large because they lay on navigable rivers. Today Smithland and Burkesville are still seats of counties untouched by rail connections and hence of inferior commercial significance. Brandenburg retains its political rule but, untouched by rail, a rail route to the south has encouraged the development of a rival trade center in Ekron.

Russellville was at this time still the leading town of southwestern Kentucky. Eldest center of settlement, social and educational capital of the district, its leadership was not lost until a further expansion of tobacco culture finally discovered the superiority of Hopkinsville as the most eligible center of the limestone plains agriculture. The early central position of Russellville at the fork of the main routes through the Pennyroyal was lost in part when the main railroads operating north out of Nashville left the town midway between them. Its own railroad to the Ohio never became more than a branch line and its only main line connections therefore are on the Louisville-Memphis route.

Other towns that were more centrally located a century ago than now are Columbia, Elkton, and Hardinsburg, all soon to experience neglect in some measure when the rail lines were

constructed. The rate of growth of these four cities since 1830 has been almost identical and shows a decided retardation as against the other five early centers, Hopkinsville, Bowling Green, both of them even then threatening Russellville as to rank, Glasgow, Elizabethtown, and Princeton. These five towns were well rewarded by the railroads with territory and thus continued to improve their position.

At the outbreak of the Civil War, shortly after the first rail lines were in operation, we find Hopkinsville securely established as the first city of the Pennyroyal, with a population more than double that of Russellville (2,289 as against 1,089). Though only on a branch rail line it had become the center of the most productive tobacco section and of the most developed agriculture in general. The leading towns at this time were still county seats with the one exception of Cloverport, strategically developed as a river port on the Ohio, at the extreme outside of a large series of bends of the river that gave to it a large and varied territory. Franklin and Cadiz had also risen to prominence as distributing centers for valuable tobacco areas. Smithland, at the mouth of the Cumberland, was then making a last bid for greatness, with a population greater by almost half than at present. The river towns in general were at this time in their best period. As railway construction recommenced after the war, their importance diminished.

Present Distribution of Town and Village Population

A slow but steady drift of population toward the towns may be noticed. There has been no boom growth in any Pennyroyal town. Those that have grown most rapidly have doubled their population in twenty to thirty years. Only a very small number of minor places are decadent, principally a few river ports and an occasional inland town that has been left to one side in the location of railroad or main highway and has been replaced by another center. Even hamlets however are for the most part growing. Transportation conditions and local tastes have not yet made superfluous any of the lesser centers as is the case in many areas to the north. Apparently much the same inertia that keeps on piling up population in the farm sections is adding bit by bit to the population of the lesser villages, commanding only the slenderest means of support as many of them do.

There does not appear to be a great deal of differentiation of towns under way at present. The smaller western towns are in general not holding their own. They lie in counties in which the drift outward of rural population is also most marked. The villages here are suffering similarly by the removal of part of the population to centers of more abundant employment. In this particular area the city of Princeton is increasing in population notably. Best supplied of the local centers with transportation facilities it is becoming a minor industrial center, employing part of the surplus population of the surrounding section.

A number of towns at the western and northern margins of the Greensburg Area have grown more rapidly of late years than the rest of the region. The most notable illustration here is Scottsville, which increased from 1,327 in 1910 to 2,179 in 1920, the largest increase both in percentage and numerically of any town in the Pennyroyal. However Elizabethtown, Campbellsville, and Glasgow have also increased by immigration from the adjacent country. Oil developments are in part responsible, but there is also a decided tendency toward the development of small manufacturing industries, for which labor from the adjacent country-side is available in this region of insufficiently large farms.

The larger towns of the Pennyroyal, Hopkinsville, Bowling Green and Somerset, have been growing only very slowly in the last decade and a half. They have apparently developed to full size as commercial and administrative centers and are still somewhat uncertain as to what success they may have in industry. That the dominant cities of the area should be thus quiescent indicates that only slow migration is taking place in the Pennyroyal. Conditions are largely static both in town and country.

Whatever growth of towns has taken place in the past century has been due almost entirely to internal migration. A few professional men have come in from the Bluegrass or from north of the Ohio. An occasional Jewish store, and Greek restaurant or candy kitchen inform us that these commercially most adventurous elements are not entirely unknown in the region. Mostly however the people of the town are natives of the county. The county began, it has been shown, as a rural community occupying a site of superior attraction. The town

is, in the majority of cases, still the county seat and still the center of the rural community. The townsmen therefore are for the most part members of the same kindred that forms the surrounding farm community. The organic unity of town and country here includes a common tribal history even for the cities of the area. Under such conditions, the ambitions of the local population not having been stirred up in the direction of town "booming," the injection of any large amount of blood from outside would be socially disturbing and has not been desired generally.

Towns of the Major Corridor: Of the local towns having more than two thousand inhabitants in 1920, nine in number, all but one lie in the corridor of the Central Pennyroyal. Of the eleven towns between one and two thousand only three are in the corridor (see Figure 121). The bigger chances for town growth have been restricted to this general site, the rest of the area having seen the developmnt only of the secondary towns.

For the most part the location of the towns and villages is directly at the base of the Clifty escarpment, at the intersection of one of the highways that flank the escarpment and of a cross-road leading across the escarpment by way of a cove. The superior importance of this general site in pioneer days has made it the principal locus of towns in southwestern Kentucky down to this day. The following group of towns and villages outlines pretty closely the margin of the scarp margin or glade country and is one of the longest and most closely spaced chains of settlement in the state. Beginning at the Ohio River at Brandenburg, we have in order Irvington, Eastview, Sonora, Upton, Bonnieville, Munfordville, Rowletts, Horse Cave, Cave City, Glasgow Junction, Rocky Hill, Smiths Grove, Oakland, Bowling Green, Auburn, Russellville, Gordonsville, Elkton, Fairview, Hopkinsville, Gracey, Cerulean, and Princeton, all at the inner margin of the limestone plain, most of them directly at the base of the Clifty escarpment. These will be referred to as "piedmont" sites with reference to the Clifty upland.

There can be no doubt that the commanding positions of the region are held by the two largest cities, *Hopkinsville* (9,696 inhabitants in 1920), and *Bowling Green* (9,638). In each the heart of the city is still formed by the public square with its county buildings, which formed the original basis of the town.

Both towns are well built and well kept, and are free from the pall of smoke which would characterize most northern cities of their size. It is evident that they are not manufacturing centers, except incidentally. Such industry as exists is the reflection of the farm trade, wagon making, the planing of lumber, flour milling, and various manufactures of tobacco. Both cities have impressive business sections.

Hopkinsville gives the more urban impression, with business structures of four and five stories, large, expensively appointed banks, and good public buildings. Many of the homes are set in large grounds, far back from the street, suggesting the aloofness of the better country places in the same section. Both towns are major agricultural markets, especially for tobacco, Hopkinsville being the greatest dark tobacco market in the state. In 1920 the loose leaf warehouses of Christian County, mostly at Hopkinsville, handled 35,000,000 pounds of dark tobacco, three-fourths of the total for the state.

The most striking features of Bowling Green are the exceptionally fine public buildings and churches. These are perhaps a reflection of the cultural position which the town holds with its normal school and smaller colleges. Certainly the interest of the well-to-do local agricultural districts in education and social advantages has been a cumulative force in the growth of both of these cities. They are not only the two best-appointed towns of the Pennyroyal but both of them will stand comparison with cities of their size in any section of the country.

Hopkinsville lies centrally to the richest body of land in western Kentucky, especially to the best tobacco country, the smooth limestone plain south of the town. It had Canton as a river port and secured rail connections before the Civil War. Controlling a favorable crossing of the sandstone belt to the north it was later connected by rail with Henderson and Evansville, the town having a further advantage in position in being about half-way between the latter cities on the Ohio and Nashville. East-west rail connections along the base of the escarpment united it with Paducah and Bowling Green, between which cities it again occupies a median position. It is fifty to sixty miles from Hopkinsville to a city of similar or greater size.

Bowling Green has a very precisely determined location. Here were the ancient ford and ferry across the Big Barren

River, the principal obstacle to travel between the Ohio and the Nashville country. South of this valley the Louisville and Nashville Railroad forks, one line going to Nashville, the other to Memphis. Bowling Green is the head of navigation on the Barren River. These very positive advantages of communication have helped the city, in a somewhat less productive country than that of Hopkinsville, to maintain an equal growth. The site of Bowling Green is superior to all others in the Pennyroyal in general accessibility, lacking a superior outlet only to the north, where the valley of the Green forms an effective barrier.

Princeton (3,689) is half-way between Hopkinsville and Paducah and controls effectively the trade of the county of Caldwell, in which it is centrally located. Its possibilities of growth are restricted by the larger cities between which it lies, but its area of trade is sufficiently remote from both Hopkinsville and Paducah so as to give opportunity for a town of secondary importance. The spacing of towns of differing orders of size is an expression of local production and of market needs. In Kentucky in general the larger centers are about sixty miles apart and midway between them one is likely to find the next smaller group of towns. Of this condition Princeton is an example. It has moreover a pass location with reference to the Clifty highland, occupied by a main line of the Illinois Central. Moreover to the southwest of the town a great bend of the Cumberland at Grand Rivers makes the most eligible crossing of both Cumberland and Tennessee rivers. It possesses therefore a rather significant crossroads location. The reduced attractions to agriculture in its tributary territory appear to facilitate its industrial development and it contains rather numerous small factories, including a woolen and knitting mill.

Russellville (3,124), benefiting in early days by its superior closeness to the Nashville settlements, in the rail period came to lie off-side. The line from Nashville to Louisville and Lake Erie left the town to one side, as did the main line from Nashville to Evansville and Chicago. Like Princeton it became the center of a more restricted territory, being situated halfway between two major centers. It is however situated on the main Louisville-Memphis line and has two branch lines that make it a trade center of some importance. *Elkton* (1,009) the next county seat to the west, having been reduced to an unfavorable position

on a short branch railroad, has seen an increasing amount of the trade of its own county diverted to more favorable shipping centers and has today fewer people than it held thirty-five years ago.

East and north of Bowling Green the towns of the Clifty piedmont sites have had less opportunity to develop into larger communities. The dissected character of the Clifty and Coal Basin country to the west has precluded the development of important roads into the Coal Basin. A narrowing of the limestone plain and somewhat rougher topography have reduced the productivity and extent of the tributary territory. A diffuse group of towns between five hundred and a thousand inhabitants therefore marks this section of the Clifty piedmont, *Smiths Grove* (815), *Cave City* (690), *Horse Cave* (864), *Munfordville* (583), dividing among themselves the trade of this section.

North of the Green River the main road and the railroad leave the western margin of the limestone country to cross the Knobs and descend to the Bluegrass and the Ohio River. Lesser roads and railroads cutting the barrier of the Clifty escarpment have established two small places, *Irvington* (655) and *Eastview* (49), the former especially favorably situated with reference to rail shipment for a relatively large and productive limestone farming country. These places however are off-side with reference to the Louisville to Nashville routes.

At the northeastern margin of the corridor the pass routes through the Knobs have aided the growth of towns on the Elizabethtown upland of the Pennyroyal. The most conspicuous location is that of *Elizabethtown* (2,530), controlling access to the Pennyroyal from the north by the main line of the Louisville and Nashville Railroad and by the Dixie Highway. Most of the trade of the limestone upland of Hardin County converges on this place, a trade that is of steadily growing importance with the development of dairying for the Louisville market. Small factories relying principally on low priced labor are favored by the proximity to Louisville and by the surplus population of the worn farm lands, especially to the east. *Vine Grove* (594) and in part, *Hodgenville* (1,100) have analogous locations.

The other original thoroughfare through the Pennyroyal corridor, now commonly known as the Jackson Highway, failed of development as a through rail route. This highway lies along

the eastern margin of the smooth country. The settlements that were early established along it have in part maintained and enlarged their significance by becoming rail heads of branch lines, relying for their support largely on the extensive territory to the east in the Greensburg Area, an area without rail facilities. Thus Hodgenville, connected by a branch rail line with Louisville has a territory to the southeast, behind the barrier of the Knobs, from which it derives trade. *Glasgow* (2,559) is a thriving trade center, with a large amount of wholesale trade carried by truck and wagon as far as the Cumberland Valley. Its four business blocks, grouped about the courthouse square, are of modern construction, with large and varied stores of goods. As in the case of Scottsville, oil developments on the western flank of the arched Waverly rocks have contributed not a little to its recent prosperity. *Scottsville* (2,179) has nearly doubled its population within a decade. It now has well-paved streets, an impressive new hotel, and a brisk business from an extensive territory to the east. In all three cases the rail head location has probably made good the lack of main line communication. With the improvement of the old highway these towns will again be restored to through connections for passenger travel at least.

At the base of the corridor, that is directly north of Nashville, conditions have been favorable for the development of a diffuse cluster of towns. Along this section of the Tennessee border lies some of the best land of Kentucky, highly developed as tobacco and stock farms. Through this area roads and railroads turn south toward Nashville. Thus *Franklin* (3,154) as county seat and hence as prior settlement, controls the trade of wealthy Simpson County, separated by the width of a county, about twenty miles, from the centrally placed county seats adjacent, Bowling Green, Scottsville, Russellville, and Gallatin. It is a perfect ilustration of the dominance of a political unit by a single adequate trade center, well placed as to rail facilities and a radial system of roads. There is no physical necessity for the existence of a city at this point, but, having been fixed upon as political center at the outset of the development of the area, it has been able to find ample support in a highly producitve territory within a radius of about ten miles. Consequently there has been no need for the development of other market places nearby. *Guthrie* (1,160) is a division and junction point

on the Louisville and Nashville system, and is the second largest town in the Pennyroyal which is not a county seat. It differs decidedly in form from the larger places previously described, lacking the court house center and the amenities that mark the county towns in all but the poorest sections of the Pennyroyal. It is a congener of small junction points anywhere in the interior states, belonging to the business of the railroad rather than to that of the pleasant country-side in which it lies. Had not Hopkinsville and Russellville antedated railroad building by two eventful generations it might well have become the principal town of this section of the state. But in Kentucky railroads have rarely created towns. If the towns have been sufficiently important the railroads sought them out, if not they have allowed them to languish. *Cadiz* (897) represents an old county seat that has fared badly. It was long without rail facilities and at the last secured a branch line. Without a sufficient territory behind it to make of it an important rail head as happened with Glasgow, with more advantageous shipping points at no great distance, it has lost distinctly in commercial significance and somewhat in population. *Adairville* (778) has a minor rail head position, marking the failure of the bid of Russellville in the 70's to secure direct outlet to Nashville. *Pembroke* (685) and *Trenton* (552), located between Hopkinsville and Guthrie at intervals of little more than half dozen miles, in the heart of the best dark tobacco country, indicate the potency of this crop in the development of lesser market centers as well as of dense rural population.

Towns of the Mountain Margin: Physically, the most advantageous site of the Mountain Margin is that of *Burnside* (1,078). The town is located at the head of navigation on the Cumberland River, at the base of the ascent to the Mountain level, used by the Queen and Crescent Railroad and an old wagon road, and at the crossing of the Cumberland Valley by the only trunk railroad above Nashville. The site of the town itself however is somewhat disadvantageous because it is situated in part on valley bottoms subject to inundation and in part on steep hillsides. Very heavy grades are involved in order to reach from it either the limestone piedmont north and southwest of the river or to pass south into the Mountains. More important in retarding its growth however is the fact that the head of

navigation on the river was not reached by many boats until the recent construction of the lock below and that the rail connection is but a half century old. Burnside is a town created by railroad. Long before its founding Somerset and Monticello, as county seats, had become important centers of trade.

Somerset (4,672) has had not only the usual advantage of the county seat, but was chosen as division point and site for important railroad shops. Southward lie the rough hills of the Cumberland in which Burnside is situated and beyond are the mountain ridges and valleys through which the railroad threads its way for scores of miles before descending into the Valley of East Tennessee. Neither Burnside nor any place to the south afforded the room and conveniences of surface demanded by large railroad yards and shops. Relief engines and additional locomotives are in demand in negotiating the ascent of the mountains to the south and in passing from the Bluegrass to the Pennyroyal level at the north. Between these two major topographic problems of this railway system lies Somerset in a smooth stretch of country. The needs of the Queen and Crescent Railway therefore have made of Somerset not an ordinary county town but the third largest center of the Pennyroyal.

Monticello (1,514) and *Albany* (579) are county seats located on the ancient highway of the limestone piedmont immediately at the base of the mountains, at the entry into important cove areas. The latter constitute not alone flourishing communities, but are passes into an extensive mountain country. Both towns also have fairly usable ridge roads leading toward landings on the Cumberland.

Towns of the Greensburg Area: The distribution of towns is distinctly marginal about this region of low attraction and moderately difficult topography. Much trade moves westward down the long slopes of the ridges toward Glasgow and Scottsville. The towns of the Mountain Margin serve as outlets for the more easterly counties. At the north, the break in the Knobs in Casey County, where *Liberty* (368), *Middleburg* (197), and *Yosemite* (155) lie in a shale basin of the upper Green that is continuous with the shale rim about the Bluegrass, has not developed into an important urban area. No railroad has used this gap and for wagon hauls the creek and river bottoms are too much blocked by water in rainy periods to attract the construction or maintenance of modern roads. Obvious as this opening is in the relief of south central Kentucky, it leads back only into the hills to the south, not through to important cities.

Greensburg (488) is the oldest town of the region and the rail head for the one rail line that effectively invades this section. It is located however in the midst of a dissected country and is rather difficult of access. The town therefore is now little more than the center of its county. In a more advantageous position on the same branch railroad lies *Campbellsville* (1,535) county seat of Taylor County, having about it a fairly prosperous, smooth upland, and easy connections to the south with an extensive ridge country across the shallow valleys of the headwaters of the Green. The town is located near the southern margin of the Knobs and commands a pass route into the Bluegrass. Paired with it is the "inland" town of *Columbia* (1,076) twenty miles to the south, the most central town of significance in the Greensburg upland, the meeting place of country roads from a number of counties. From here a large quantity of goods is freighted by wagon and truck to and from the railroad at Campbellsville. Columbia is even a minor wholesale distributing center for these interior counties. *Tompkinsville* (721) has a similar relationship to the rail head of Scottsville at the southwestern margin of the Waverly upland. *Burkesville* (798) is the lone river town on the Cumberland below Burnside that has retained major commercial importance. It is living in expectation of better days when the river will be regulated. Meantime it has a number of valley communities dependent on it, is producing oil and speculating in oil prospects, and handles freight by river when the water will permit, otherwise hauling its goods from the distant rail head at Glasgow.

Towns of the Clifty Margin: Toward the limestone plain the Clifty Area presents an escarpment, at the base of which lie most of the important towns of the Pennyroyal. Towards the Coal Measures the Clifty Area is in somewhat the same position that the limestone plain bears toward the Clifty upland. Where transportation lines cross the Clifty Area we are likely to find therefore a settlement hard against the margin of the rougher Coal Measures the Clifty Area is in somewhat the same position paired with the major towns located where such routes reach the Pennyroyal Plain. Thus *Crofton* (527) is an outpost of

Hopkinsville at the northern border of the Clifty upland. *Lewisburg* (334) has an identical relation to Russellville.

The Northern Clifty area has been less completely dissected than at the south and forms in part two fairly distinct plateaus, one between the Ohio and Rough rivers, the other between Rough and Nolin rivers. In the central and smoothest parts of these uplands are the two county seats, *Hardinsburg* (810) and *Leitchfield* (1,077) each on a rail route and at a convergence of numerous ridge top haul roads.

Cloverport (1,509), nominally in this area, owes its significance originally to the advantage of its river-head position for shipments of lumber, coal, and farm produce from both Clifty and Coal Measures upland behind it. Later it secured the shops of the Louisville, Henderson, and St. Louis Railroad and since then has been maintained by the railroad pay-roll.

Towns of the Western Margin: Here two principal types of location are found, river ports and basin centers. *Fredonia* (477) and *Salem* (252) are pure types of village centers developed in a fault-block basin. *Smithland* (559), county seat of Livingston County, is located at the junction of the Cumberland and Ohio rivers. Once an important river port, it is now the most seriously decadent town in the whole region. The streets are lined with old buildings, many of them now unused. The large hotel, once a busy place, now finds so little use that only the smaller part of the building is kept open. What is left of the river business is carried on from Paducah as terminal, Smithland being but one among many river landings. *Eddyville* (1,182), *Kuttawa* (850), and *Grand Rivers* (478), divide among themselves the site value of the important crossing of the Interfluve Area by railroad and road. The first of these places, as site of a state prison, has an importance not dependent entirely on local support. Partly anomalous is the location of *Marion* (1,718), centrally located as county seat in the very confused surfaces of the fault-block country, supported in part by fluorspar mining, and fairly well situated on a central water parting.

Conclusion

The potency of the county seat in the Pennyroyal is shown by the following facts: (1) The first twelve towns are all county seats. (2) The twenty places having a population of more than a thousand inhabitants include only three places that are not county seats. (3) Among the thirty towns having more than seven hundred inhabitants seven are not county seats. (4) Even in those counties in which the seats are small villages, they are ordinarily the largest centers in their county. To this condition there are only two exceptions in the Pennyroyal, in Breckinridge County where the railroad-shop town of Cloverport is about twice as large as the county seat, Hardinsburg, and in Hart County, where Munfordville, the county seat, situated in the dissected belt of the Green River, is surpassed by Horse Cave with a good farming upland tributary to it. In all cases the county seats were established in the first years of settlement. Their present preeminence is not due therefore to a shifting of the seat of justice to the most important place but reflects the importance of the administrative center in attracting population and also the fact that the county is normally really a coherent community developed about a valid nucleus, the original choice of the county seat being little more than the official ratification in a normal process of growth.

It is not likely that the near future will witness many revolutionary changes. The number of towns, it is more likely, will diminish rather than increase. The period of founding towns is almost certainly over, the area apparently being without such mineral resources as might result in new locations. The improvement of highways will increase the advantages of those places that are at the most important cross-roads. Industrial development of the area is possible, in view of the excess of population over land, the nearness of coal, and the convenient rail connections. The larger towns therefore may grow considerably larger if the needed initiative is supplied. There is little prospect, however, that within any brief period the Pennyroyal will become anything else than it is now, a quiescent rural area, dotted with small cities, country towns, and cross-roads hamlets.

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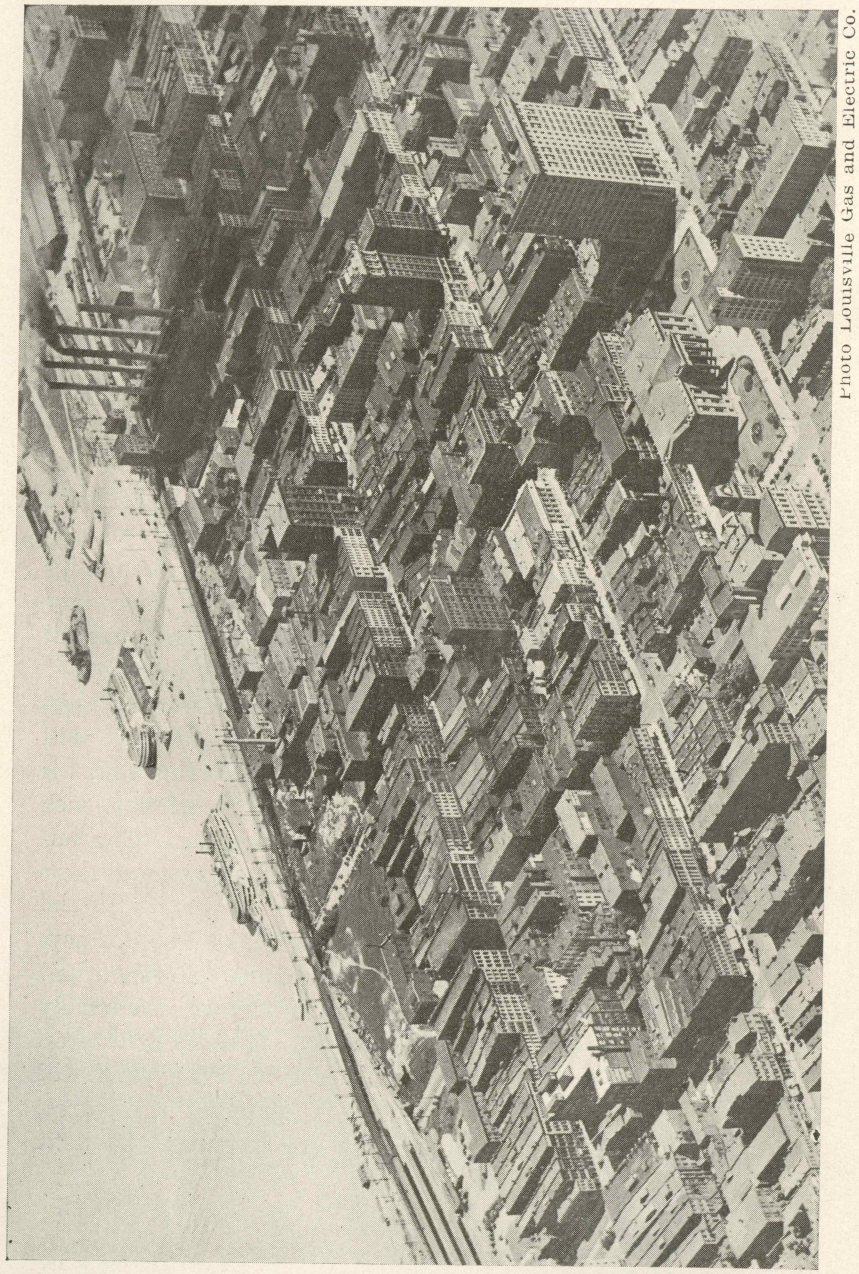

Photo Louisville Gas and Electric Co.

A PORTION OF THE BUSINESS DISTRICT OF LOUISVILLE FROM THE AIR.

LOUISVILLE

A PRELIMINARY STUDY OF THE INFLUENCE OF GEOLOGY PHYSIOGRAPHY, AND MINERAL RESOURCES UPON THE INDUSTRIAL AND COMMERCIAL DEVELOPMENT OF A CITY

By

WILBUR GREELEY BURROUGHS
Assistant Geologist

KENTUCKY GEOLOGICAL SURVEY
1927

Letter of Transmission

DR. WILLARD ROUSE JILLSON,
Director and State Geologist,
The Kentucky Geological Survey,
Frankfort, Kentucky.

Dear Sir:

Permit me to transmit herewith my manuscript of a report on "Louisville: A Preliminary Study of the Influence of Geology and Physiography upon the Industrial Development of the City."

Since this is a short preliminary report, and the length is limited, a number of topics are discussed but briefly that otherwise would have been developed fully. In the space allotted, however, an attempt has been made to show how geologic and geographic factors have controlled Louisville's industrial and commercial growth, and how these same factors will continue to operate in making Louisville one of the great industrial and commercial cities of the United States.

The field work for the report was carried on by the author in December, 1926. Acknowledgment is here made to the Louisville Gas and Electric Co. for kind co-operation in providing the excellent airplane view of Louisville used as frontispiece in this report.

Respectfully submitted,

WILBUR GREELEY BURROUGHS,
Assistant Geologist.

Berea, Kentucky,
March 24, 1927.

LOUISVILLE

By

WILBUR GREELEY BURROUGHS
Assistant Geologist

SPACE RELATIONSHIPS

Location.—Louisville, Jefferson County, Kentucky, is located along the southern bank of the Ohio River on the central northwest margin of the State. It lies in North Latitude 38° 15′ 31.6″, West Longitude 85° 45′ 54.77″.

The city is equi-distant between the Gulf Coast and Lake Superior, and over one-third the way from the Atlantic Coast to the Rocky Mountains. With Louisville as a center, the circumference of a circle having a 500 mile radius all but touches the Gulf of Mexico, meets the Atlantic off the Carolinas, strikes eastern Pennsylvania, Lake Ontario, northern Michigan, southeastern Minnesota, eastern Kansas, and crosses the Mississippi part-way down the Louisiana boundary. Louisville is equidistant in hours of travel from Dallas, Omaha, Minneapolis, Toronto, New York City, Charleston, Jacksonville, and New Orleans.

The distance by rail from Louisville to Atlanta is 474 miles; Birmingham, 392 miles; Chicago, 311 to 324.9 miles; Cincinnati, 113 miles; Knoxville, 277 miles; Nashville, 187 miles; St. Louis, 274 miles. Where more than one railroad can be used the distance may vary according to the line chosen.

Highway mileage from Louisville to Atlanta, via Nashville, Chattanooga, is 515 miles; Chattanooga, via Nashville, 373 miles; Chicago, via Paoli, Crawfordsville, Danville, 344 miles; Cincinnati, via Scottsburg, Seymour, Aurora, 155 miles; Cleveland, via Cincinnati, Columbus, Wooster, 458 miles; Detroit, via Indianapolis, Dayton, Toledo, 444 miles; Evansville, via Paoli, French Lick, Booneville, 146 miles; Frankfort, via Shelbyville, 51 miles; Indianapolis, via Scottsburg, Seymour, Columbus, 125 miles; Jacksonville, via Nashville, Atlanta, Valdosta, Lake City, 884 miles; Knoxville, via Lexington, Mt. Vernon, Corbin, Middles-

borough, 302 miles; Lexington, via Frankfort, Versailles, 79 miles; Lincoln Farm, via Elizabethtown, 65 miles; Mammoth Cave, via Elizabethtown, Cave City, 100 miles; Memphis, via Cairo, Sikeston, Blytheville, 520 miles; Nashville, via Elizabethtown, Bowling Green, Scottsville, 205 miles; New Orleans, via Memphis, Greenwood, 994 miles; New York, via Columbus, Hagertown, Baltimore, 906 miles; Pittsburgh, via Cincinnati, Columbus, Wheeling, 499 miles; St. Louis, via Paoli, Vincennes, Sandoval, 286 miles.

The center of population of the United States is about eighty miles northwest of Louisville, being 8.3 miles southeast of Spencer, Owen County, Indiana. (Ref. 30.) In 1920 Louisville was 44 miles northwest of the center of population of Kentucky, which was 2.5 miles northwest of Springfield, Washington County. With Louisville as a center a circle with a radius of 635 miles will include every city in the United States with a population of 500,000 with the exception of three larger cities in New England and on the Pacific Coast. (Ref. 9.)

Louisville is also located advantageously to areas producing coal, iron, and other essential minerals, timber, cotton, tobacco, grain, cattle, and other agricultural products, and to markets possessing immense purchasing power.

Physiography

Relief.—Louisville lies within the Interior Plains of the United States, along the Ohio River section of Kentucky, and spreads over onto the Knob Belt. Jefferson County in which the city is located, has several types of relief: (1) In the southwestern part of the county are the rougher knobs. They rise 120 to 350 feet above their valleys. (2) Southeast and southwest of Louisville are lowlands. The flat area in the vicinity of South Park formerly was a swamp but has been reclaimed by drainage. The lowland along the Ohio River southwest of Louisville still contains swampy land. The main portion of the city is built on elevated level land around 60 feet above the Ohio River. Low water above the "Falls of the Ohio" is 386 feet about sea level. The elevation at the front entrance to the courthouse, bronze tablet "463," is 463.075 feet.

(3) To the east of Louisville for a short distance the surface becomes slightly dissected by stream erosion, then again flattens out in the Beargrass Creek district.

(4) Northeast of the city a low, narrow, level strip extends along the Ohio River, with the higher land adjacent on the southeast trenched 100 feet in depth by streams flowing into the Ohio.

(5) To the northeast of the flat South Park area an escarpment stretches to the northeast along a line drawn approximately through Okolona and Bryan. This escarpment is the edge of a dip slope on the Louisville limestone. (Ref. 6:21.) The relief to the east consists of quite broad ridges and spurs sloping down to the bottomlands.

(6) The eastern one-third of the county on both sides of Floyd's Fork is a dissected upland.

Drainage.—Jefferson County drains into the Ohio River which flows along the northern to western boundary. At Louisville are found the series of rapids called the "Falls of the Ohio" which have a total descent of about 26 feet. They are caused by Onondaga limestone of Devonian age which here contains quantities of hard fossil coral. These rapids have been an important factor in the history of Louisville. At present other forces are making Louisville one of the great cities of the contient. The falls promise soon, however, to become a rejuvenate industrial force of great permanent value to the city as a source of hydro-electric power. Two-thirds of the northwestern part of Jefferson County drains directly into the Ohio River, the principal streams being Harrods Creek, Little Goose Creek, Goose Creek, Beargrass Creek and its branches, Mill Creek, Pond Creek, Fern Creek. The remaining third of the country is drained by Floyds Fork and its tributaries. Floyds Fork flows southwestward and empties into Salt River which in turn enters the Ohio near West Point.

Geology

Strata outcropping in Jefferson County extend from the Richmond of the Ordovician through the Silurian and Devonian to the Spergen epoch of the Mississippian, inclusive. After the Spergen there is an absence of strata in Jefferson County until Quaternary times. In the Pleistocene epoch the southern margin

of the ice sheet extended just to the north of Jefferson County. Detritus from the melting ice filled the Ohio River bed to a depth of about 150 feet bringing the top of the fill about 500 feet above sea-level. With the retreat of the glacier northward, the river cut a channel but this time, due to the surface, the course was as seen at the present time, whereas the preglacial course of the river bed had been through where now stands the main portion of the City of Louisville. During Recent times the Ohio River has deepened its channel 80 to 100 feet below the top of the glacial fill described above. Also 20 to 40 feet of the entire surface of the glacial deposit have been eroded away. Thus the alluvial terrace was formed which borders the Ohio above and below Louisville and which lies 20 to 30 feet below the present general level of the glacial outwash terrace upon which Louisville is built. (Ref. 6:204.)

In structure the strata of Jefferson County dip in a general westward or slightly northwestward direction. The average dip is about 44 feet per mile. Anticlines and synclines occur. Chief of these is the Lyndon syncline and the Springdale anticline named after the towns through which their axes pass. (Ref. 6:177, 178.)

Climate

Louisville has a humid, temperate, continental type of climate. The accompanying tables show monthly and annual climatic conditions.

Climatological Data for Louisville*

MEAN PRECIPITATION (INCHES)

Length of Record, Years	January	February	March	April	May	June	July	August	Sept.	October	November	December	Annual
57	4.00	3.67	4.44	4.11	3.70	4.02	3.91	3.33	2.66	2.67	3.68	3.81	44.00

AVERAGE MONTHLY AND ANNUAL SNOWFALL (INCHES)

38	4.8	4.3	2.3	0.3	T.	0	0	0	0	T.	0.3	3.2	15.2

AVERAGE NUMBER OF DAYS WITH 0.01 INCH, OR MORE, PRECIPITATION

Length of Record, Years	January	February	March	April	May	June	July	August	Sept.	October	November	December	Annual
50	12	11	12	12	11	11	10	9	8	8	9	11	124

MEAN RELATIVE HUMIDITY, PERCENTAGE

7 A. M.

34	79	78	75	71	72	74	74	78	79	78	76	78	76

7 P. M.

34	70	67	62	57	58	59	57	59	59	58	62	68	61

SUNSHINE, PERCENTAGE OF POSSIBLE

28	42	49	52	56	62	68	70	69	68	66	54	40	58

MEAN TEMPERATURE (DEGREES F.)

50	34.7	36.4	46.0	56.2	66.6	74.9	78.8	76.9	70.6	59.0	46.6	37.6	57.0

MEAN MAXIMUM TEMPERATURE (DEGREES F.)

50	42.5	44.7	54.9	65.7	76.3	84.4	88.2	86.4	80.5	68.9	54.9	44.8	66.0

MEAN MINIMUM TEMPERATURE (DEGREES F.)

50	26.9	28.2	37.1	46.7	56.8	65.4	69.4	67.4	60.7	49.1	38.2	30.3	48.0

HIGHEST TEMPERATURE (DEGREES F.)

50	74	78	88	91	98	101	107	105	102	91	79	74	107

LOWEST TEMPERATURE (DEGREES F.)

50	—20	—14	3	21	33	43	54	47	36	26	4	—7	—20

FROST DATA

No. of Years of Record	Average Date of Last Killing Frost in Spring	Average Date of First Killing Frost in Autumn	Average Length of Growing Season—Last Killing Frost to First Killing Frost (Days)	Latest Date of Killing Frost in Spring	Earliest Date of Killing Frost in Autumn
51	Apr. 10	Oct. 21	194	May 14	Sept. 30

PREVAILING WIND DIRECTION

Length of Record, Years	January	February	March	April	May	June	July	August	Sept.	October	November	December	Annual
50	s.	s.	s.	s.	s.	sw.	sw.	s.	n.	n.	s.	sw.	s.

AVERAGE HOURLY WIND MOVEMENT (MILES)

50	9.5	10.3	10.5	9.6	7.9	7.4	6.7	6.4	6.8	7.5	8.8	9.2	8.4

*Climatological data based on the U. S. Weather Bureau report. Climatological data for the U. S., by sections, Sec. 76, Western Ky., 1922.

History of Louisville

The first exploring and surveying party to reach the present site of Louisville was lead by Captain Thomas Bullitt, who, on July 8, 1773, pitched camp above the old mouth of Beargrass Creek. (Ref. 8, vol. II, 358.) These men remained for several weeks carrying on their work in what are at present Jefferson and Bullitt counties and laying out a plan for a settlement at Louisville. In the spring of 1778, General George Rogers Clarke at the head of 150 men, came down the Ohio on an expedition against the British and Indians in the Illinois country. Under his protection came a number of pioneers and their families who wished to settle in Kentucky. Clarke landed on Corn Island, an alluvial deposit opposite the foot of Tenth Street of the present day, as he considered it to be safer than the mainland from attacks by their enemies. Here he erected blockhouses and cabins for the settlers, made it his own base of supplies, and continued on his campaign. In the fall of the same year, Clarke having returned successful, the settlement was removed to the mainland where a fort and cabins were constructed. The spring of 1779 saw the arrival of pioneers from Virginia. A town was laid out and named Louisville in honor of Louis XVI of France. It was incorporated as a town in 1780, and as a city in 1828. (Ref. 8, vol. II, 355.)

At the same time the county in which Louisville is situated was being formed. The Virginia legislature in May, 1780, divided Kentucky County into the counties of Jefferson, Fayette, and Lincoln. Jefferson County was named in honor of Thomas Jefferson who became President of the United States. Much valuable land was preempted in Jefferson County prior to statehood. (Ref. 14 and 15.) These three original counties have since been subdivided into the counties of the State of Kentucky, Jefferson County of today having an area of 247,680 acres and being located on the central northwest boundary of the Commonwealth.

The growth and prosperity of Louisville were assured from the beginning due to its geographic position, being located at the "Falls of the Ohio," which were navigable in places when the water was high, but in general for many years caused a break in river navigation. It was thus situated at the head of unimpeded navigation of the Mississippi-Ohio river system. Goods started by river from Louisville for the South, and goods were brought from the South upstream to Louisville for distribution. Above the Falls Louisville had a similar advantageous position on the Ohio River.

Trade conditions of early times are described by Ellen Churchill Semple (Ref. 28) as follows: "It was the western terminal of a route of trade connecting the lower Ohio with Philadelphia and Baltimore, and therefore a distributing point; and it held a central position on the old trail of the French voyageurs, who brought the furs from the Great Lakes down the northern tributaries of the Ohio, on down the Mississippi to New Orleans, to exchange them for the southern products of Louisiana.

"The Ohio was the natural channel by which immigrants came to the Falls, and commodities for their use were imported from the East. Wagon trains or pack mules crossed the mountains from Philadelphia to Pittsburgh, or from Baltimore to

Wheeling, and their merchandise embarked on the river for Louisville, where it was sold. The profits of the sale were immediately reinvested in western produce, which was shipped to New Orleans and there exchanged for West Indian products, and the rice, sugar, cotton, and molasses of Louisiana. Louisville, because of its frontier position, was made a port of entry by Congress in 1799, and a collector appointed to prevent the smuggling of foreign goods from New Orleans, which was at that time a foreign port; but after the cession of Louisiana in 1803 this office was abolished. For the first decade of its history Louisville relied chiefly on Pittsburgh for its trade; but as the population of the valley increased, New Orleans was looked to as the natural market for western products." Important products of commerce were tobacco, whiskey, flour, pork, lard, bacon, rope, and salt.

In 1806 two barges of 30 and 40 tons, and six keel boats carried all of the river commerce of Louisville and Shippingport. In October, 1811, Fulton's steamboat "Orleans," built in Pittsburgh, arrived at Louisville. More steamboats were constructed and the trade of Louisville expanded. In 1841 cabin passengers on the best boats from New Orleans to Louisville were charged ten to fifteen dollars each, and freight fifteen cents per one hundred pounds. These boats made seven to fifteen miles an hour up, and ten to eighteen miles downstream. The trip from New Orleans to Louisville took five to eight days, and the return four to five days. (Ref. 8, vol. II, 361, 362.) The river traffic was so often retarded by low water at the "Falls of the Ohio," that a canal was completed around the "Falls" in 1830. The high toll rates at the canal, however, caused boats from downstream to continue to stop and unload and load at Portland just below the Falls. The goods were carried around the Falls by drays. Eventually the government acquired the canal and it has been enlarged and improved.

A railroad into the Bluegrass in 1851 stimulated commerce. And with the operation of the Louisville & Nashville Railroad to Nashville in 1859, commerce from Louisville on the Ohio River diminished and transportation by rail increased. The railroad made Louisville a gateway into the South of far greater importance than river navigation could ever have done. The Civil War at first paralyzed Louisville's trade, but then stimulated

its activities when the city became a great supply depot for the Union armies operating to the south, land transportation being over the Louisville & Nashville Railroad. Even with cessation of hostilities commercial activities continued to expand.

Manufacturing has played a vital part in Louisville's prosperity since about 1870. All of the fundamental factors for success of manufacturing industries are here, such as power, fuel, raw materials, labor, transportation facilities and good markets. These factors are discussed under their respective topics later in this report. And so Louisville has continued to grow steadily, surely, without artificial stimulus.

POPULATION OF LOUISVILLE

Color or Race, Nativity and Sex	1920*	1925†	1926†
Total population	234,891	305,935	311,000
Male	112,159		
Female	122,732		
Native white—native parentage	139,403		
Native white—foreign parentage	27,076		
Native white—mixed parentage	16,669		
Foreign born white	11,621		
Negro	40,087		
All other nationalities	35		
Age, School Attendance, and Citizenship			
Total under 7 years of age	25,540		
Total 7 to 13 years, inclusive	26,902		
Number attending school	25,713		
Total 14 and 15 years	7,125		
Number attending school	5,585		
Total 16 and 17 years	7,721		
Number attending school	2,354		
Total 18 to 20 years, inclusive	12,311		
Number attending school	1,184		
Males 21 years of age and over	73,447		
Native white—naitve parentage	38,390		
Native white—foreign or mixed parentage	15,484		
Foreign-born white	5,679		
Negro	13,868		
Females, 21 years of age and over	81,845		
Native white—native parentage	41,508		
Native white—foreign or mixed parentage	19,730		
Foreign-born white	5,503		
Negro	15,098		
Males 18 to 44 years, inclusive	51,768		
Females 18 to 44 years, inclusive	58,574		
Illiteracy			
Total 10 years of age and over	197,886		
Number illiterate	7,946		
Native white	151,095		
Number illiterate	1,828		

Foreign-born white	11,569
Number illiterate	869
Negro	35,187
Number illiterate	5,245
Total 16 to 20 years, inclusive	20,032
Number illiterate	125
Illiterate males 21 years of age and over	3,518
Illiterate females 21 years of age and over	4,229
Dwellings and Families	
Dwellings, number	47,449
Families, number	60,490

*Data from U. S. Census Report, 1920.
†Special local census.

Across the Ohio River in New Albany, Jeffersonville, Clarksville and Port Fulton, Indiana, is a population of 50,000; and 30,000 population in suburban towns in Jefferson County. (Ref. 23).

Factors of Industrial Growth

Louisville possesses to an unusual extent all of the elements necessary for industrial and commercial growth. It is strategically situated with relation to raw materials. There is an abundant supply of power, efficient labor, and excellent transportation facilities to raw materials and markets.

Natural Resources

The natural raw materials comprise mineral products, water resources, soils, agricultural products, both plant and animal, native vegetation of which timber is an important part.

Mineral Resources of Jefferson County.—In Jefferson County the mineral resources consist of limestone, clay, shale, sand, gravel, a little gas, oil shale, mineral water. The Ohio River is a source of water power.

Stone.—The limestones used for building purposes, including masonry and curbing are from the "Louisville," "Laurel," and "Saluda" formations. (Ref. 6:207.) They are of various shades of gray and occur in large amounts. Other limestones in Jefferson County as well as these mentioned, are used for walls, chimneys, fences, and agricultural lime. Limestone for road metal is obtainable over a wide extent of the county and this has been a factor in the construction of the numerous good roads found near Louisville.

The Jeffersonville limestone where sufficiently pure, is a source of material for the manufacture of lime. It is 20 feet thick and covers a broad area. It is also of a composition suitable to be used in Portland cement. Natural cement has been obtained from the Silver Creek hydraulic limestone. This formation is not over 10 feet thick and underlies the city of Louisville, thinning toward the eastward. It was formerly quarried at the foot of 14th Street near the Pennsylvania railroad bridge. Natural cement, however, is not used as much as in earlier times, so that the Silver Creek formation is of slight economic importance.

Clay and Shale.—Clay and shale for the manufacture of brick, hollow tile and similar clay products occur in large quantities. They comprise: The alluvial clays bordering the Ohio River, none of which are worked; the Rosewood shale of the Waverly, Mississippian age, which occurs topping the knobs near Coral Ridge, south of Kosmosdale and west of Brooks; the New Providence shale of the knobs which is excellent and occurs in large amounts; the Jeffersonville limestone residual clay which overlies this limestone formation over a considerable area. Clay used in the manufacture of Portland cement at Kosmosdale is obtained from the surface of the glacial outwash terrace near the plant. The limestone used is brought from near Brandenburg, Kentucky, and is of Upper Mississippian age.

Sand and Gravel.—Sand occurs in great quantity. Deposits of the Ohio River extend northeast from Louisville for over ten miles. It is used in plaster, mortar, cement, and concrete. When washed, dried, and screened it would make a good glass sand. (Ref. 25:91.) As the sand is taken from the river bottom, new sand is washed in to take its place. Ohio River sand deposits also occur southwest from Louisville. Molding sands are found near Louisville. Gravel is obtained from the river deposits. Also there are sands on the land in and near the city.

Natural Gas.—A small amount of natural gas has been obtained from the Ohio (New Albany) shale in the southwest part of Jefferson County. Gas was discovered in large quantities in 1863 in Meade County and later the gas was piped to Louisville, but by 1917 the field was practically abandoned. (Ref. 11:26-28.)

Artificial Gas.—The Louisville Gas & Electric Company manufactures artificial gas at their large plant described under the topic Public Utilities.

Oil Shale.—In the future when oil wells flowing or being pumped are exhausted and the price of petroleum and its by-products increases sufficiently, the Ohio shale will be an imporant source of oil and gas. The oil shale of Jefferson County yields on distillation 15.50 gallons of oil and 5,000 cubic feet of gas per short ton. The specific gravity of this shale is 2.198 and the weight 136.78 pounds per cubic foot.

Water Resources of Jefferson County.—Spring and well water may be obtained usually at the following horizons: the top of the Louisville limestone just below the Ohio black shale; the bottom of the Louisville limestone or top of the Waldron shale; or the top of the lower shale of the Osgood. For example, some wells are located in the top of the Louisville limestone in the Ohio shale area north of the knobs, and wells are located in the Osgood shale near Buechel. The Richmond formation in eastern Jefferson County furnishes a few springs and wells. In Louisville the glacial outwash terrace deposit furnishes many wells 20 to 100 feet deep. Water from wells of ordinary depth should be viewed with suspicion for drinking purposes as, though it may be pure, there is a chance that it may have become contaminated.

Very deep wells are believed to penetrate the St. Peter sandstone, and yield a salt-sulphur water. Certain of these mineral waters are used for medicinal purposes.

Water power from the Ohio River to be used for the development of electricity is discussed under the topic Power.

Mineral Resources of Kentucky.—The State of Kentucky, outside of Jefferson County, contains the following mineral products in economic quantities. Arranged in alphabetical order they are as follows:

Abrasives.—Sand, gravel, and sandstones suitable for various uses as abrasives, occur in large amounts near rail and water transportation. These deposits are described under the topic sand, gravel and stone. Hones are made at Elizabethtown.

Aragonite (Kentucky Onyx).—This beautiful mineral, also known as Mexican Onyx, is found in and near the caves of Edmonson and Hart counties. Large deposits occur along the Hart, Barren, and Edmonson county lines. Kentucky onyx takes a high polish and is used for interior decoration. It awaits development.

Asphalt Rock.—The most important deposits of this fine road material are found in Edmonson, Grayson, Breckinridge, Hardin, and other counties along the eastern and southern border of the Western Coal Field. It is also found in smaller areas in Carter, Johnson, Magoffin and Morgan counties of the Eastern Coal Field. The industry is just beginning to become important. There is much room for expansion.

Barite.—Veins of barites occur in the limestones of the Bluegrass as in Fayette, Boyle, Garrard, and other counties. When washed, barite is used in the manufacture of paper, for coating canvas ham sacks, in pottery glazes, in chemicals, and for numerous other purposes. Its chief use is in paint mixed with white lead, zinc white, and the like. Barite forms one of the principal elements in lithopone.

Calcite.—A commercial vein of calcite six to sixteen feet wide, nearly vertical, and traceable for over one mile, is seen near Mundy's Landing in Mercer County. Other veins of lesser importance occur in the state. Calcite is used in the manufacture of putty, paint, optical glass, etc.

Cannel Coal.—Kentucky contains the largest quantities of cannel coal in the eastern United States. Beds occur at Cannel City, Morgan County, and in Carter, Floyd, Bell, Greenup, Hancock, Breckinridge, and other counties.

Carbon Black.—Carbon black is manufactured from natural gas in Floyd, Green, Lee, Taylor, and Whitley counties. Other isolated gas fields exist that can be utilized for the manufacture of this product, if desired. Carbon black is used in the manufacture of printing inks, automobile rubber tires, paints, stove and shoe polishes, phonograph records, black leathers, buttons, typewriter ribbons, and many other articles.

Cement.—The only Portland cement plant in Kentucky, is located near Louisville at Kosmosdale. Other plants are situated in Indiana and Ohio within easy reach of Louisville. Enormous amounts of limestones and clays or shales suitable for Portland cement occur in Kentucky. Coal can be readily se-

cured. The establishment of additional plants is thus a matter chiefly of markets.

Clay Products.—Kentucky is rich in clays and shales suitable for common brick and the like. In the northeastern part of the State is a long, wide belt of fire clay deposits. High grade clays and pottery clays are found in the Jackson Purchase, Madison County, and elsewhere. They are all within ready shipping distance of Louisville. The products manufactured from these clays and shales include: common, rough textured, pressed and paving brick; hollow blocks; flue linings; floor, wall, and roofing tile; drain tile; sewer pipe; chimney tops; fire brick and other refractory products; red earthenware; stoneware; electrical porcelain; sanitary ware; white earthenware; art pottery, and other articles.

Coal.—Kentucky contains an Eastern and Western Coal Field. The Eastern Field is 10,450 square miles in area, the Western Field 4,680 square miles. Coals of commercial importance that occur in counties bordering Pine and Cumberland Mountains are low in sulphur. Many of these coals show less than 0.75 per cent sulphur, and all commercial coals less than one per cent sulphur. Coals from the western border counties of the Eastern Coal Field run higher in sulphur varying from more than one per cent to almost three per cent. Commercial coals of the Western Coal Field are higher in sulphur than any of the Eastern Kentucky coals. The lowest county average of sulphur from the Western Field is 3.22 per cent.

A representative analysis of the well known Elkhorn coal of Eastern Kentucky is as follows:

Analysis of Elkhorn Coal (air-dried sample).

	Per Cent
Moisture	1.58
Volatile combustible matter	30.78
Fixed carbon	64.24
Buff-gray colored ash	3.40
Total	100.00
Sulphur	0.47
B. T. U. per pound	13,740.

(Sample collected by Dr. W. R. Jillson, State Geologist. Analysis by W. D. Iler. A. M. Peter, Chief Chemist. Lexington, Ky., April 27, 1923.)

(Ref. 12:58.)

Average of Analyses of Coals Nos. 6, 9, 11, 12, 14 of the Western Coal Field (Air-Dried Basis).

	Per Cent
No. of analyses	73
Loss air-drying	2.88
Moisture	3.33
Volatile	37.73
Fixed carbon	49.90
Ash	8.91
Sulphur	3.22
B. T. U.	12,898.
Ratio fuel	1.32

Ref. 5:37.)

Eastern Kentucky coals as a whole, are used largely in by-product coke plants and in illuminating gas plants, and also as a domestic fuel. Western Kentucky coals are used chiefly for steam making by both railroads and industrial plants, and for domestic fuel. They are used in coke making to a lesser amount than the coals of Eastern Kentucky.

Coke.—Coking coals and coals excellent for the manufacture of artificial gas, occur in the Eastern and Western Coal Fields of Kentucky. A by-product coke plant is situated at Ashland, while coke is made at artificial gas plants in other cities. Beehive coke is made chiefly in the Eastern Coal Field.

Fluorspar.—Kentucky contains both a Western and a Central Fluorspar Field. The Western Field in Crittenden, Livingston, and Caldwell counties, lies across the Ohio River from the great fluorspar field of Illinois. Louisville is thus near the two largest fluorspar fields in the United States. The Central Fluorspar Field of Kentucky is southwest of Lexington along the Kentucky River. Fluorspar is used chiefly as a flux in the manufacture of steel. It is also employed in the ceramic industries, in the manufacture of hydrofluoric acid, and for other purposes.

Gravel.—Gravel is obtained from the Ohio and other rivers, from gravel deposits on the dry land, and from weathered conglomerate outcrops.

Iron.—Kentucky contains large areas of low grade iron ore, but they will not be of economic value under present conditions until the high grade ores of the Lake Superior and Appalachian fields have become exhausted. Louisville is favorably situated, however, for the manufacture of iron and steel products. Sev-

eral steel mills and iron works are located at Ashland, Newport, and Louisville.

Lead.—Lead ores are obtained chiefly in the mining of the fluorspar veins. The lead ores are separated from the fluorspar at the mills and shipped to smelters outside the State. A lead vein was formerly worked in Owen County.

Lime.—Limestones suitable for the manufacture of lime occur in immense amounts. Of especial value are the Ste. Genevieve and Gasper formations of the Knobs and Mississippian Plateau, and the Tyrone of the Bluegrass.

Lithographic Stone.—This limestone occurs in Estill and Meade counties.

Marble.—Limestone that takes a good polish is termed "marble." Kentucky contains large quantities of this type of "marble," as for example the Kentucky River Marble, Kentucky Marble, and many other kinds.

Marl.—Calcareous shales and clays or marls, are found in many areas of the State. They are of value to spread on the fields instead of crushed limestone. Marl increases the farm crops.

Mineral Waters.—Saline, salt-sulphur, chalybeate, lithia, epsom, sulphur and other mineral waters occur in Kentucky. They are shipped to Louisville in bulk, and are also partially evaporated and sent to market in concentrated form. Mineral springs also occur in Indiana. Spring water for ordinary table use is shipped to Louisville from nearby springs in Oldham and other counties.

Natural Gas.—The main physiographic divisions of Kentucky contain gas fields of greater or lesser value, with the exception of the Bluegrass and Jackson Purchase. Natural gas is piped to Louisville from Eastern Kentucky and West Virginia.

Natural Gas—Gasoline.—This product is obtained from natural gas in several counties.

Ochre.—Ochre occurs in Kentucky, though thus far it has not been developed.

Oil Shale.—The most important deposits are those of the Ohio black shale which outcrops chiefly throughout the Knob Belt. The oil content varies from 8 to 27.75 gallons of oil and 3,000 to 10,000 cubic feet of gas per ton of shale.

Petroleum.—Kentucky is an important producer of oil which is obtained from numerous fields scattered through all of the main physiographic divisions of the State, except the Bluegrass and Jackson Purchase. There are several refineries located at Louisville.

Phosphate Rock.—Brown phosphate occurs in commercial quantities in the Inner Bluegrass. It is mined near Wallace, Woodford County. Phosphate rock is used in fertilizers, in the manufacture of chemicals such as phosphoric acid, and for other purposes.

Salt.—Salt water occurs in former oil wells, and natural brines can be obtained in the Leitchfield district of Grayson County. Salt is used in the meat packing and chemical industries, for table use, and the like.

Sand.—Kentucky possesses an unlimited amount of sand which can be utilized for general purposes, glass sand, and molding sand.

For general purposes it is dredged from the Ohio and other rivers, excavated from alluvial deposits, and obtained from weathered sandstones.

Glass sands are found in three main fields and in smaller, isolated deposits. The principal districts are: (1) the Eastern Kentucky Field from Greenup to Pike County, including Carter and Rowan County deposits; (2) the Northern Field from Carroll to Grayson County; (3) the Western Field, including Caldwell, Crittenden, and Hopkins counties. Glass plants should find Kentucky an excellent place to locate, for here are the raw materials sand, natural gas, coal for the manufacture of artifical gas, fluorspar, together with excellent transportation facilities and markets.

Molding sands are obtained from the deposits that occur near the Ohio River below Cincinnati to Trimble County. They also are found in Jefferson, Bullitt, Hardin, and numerous other counties including those of the Jackson Purchase.

Stone.—Limestone and sandstone occur in inexhaustable quantities and are widely distributed. Among the building stones the Bowling Green limestone is well known; and of the sandstones the Rowan, and Rockcastle freestones have been used for a long time.

Water Resources.—The present and potential development of hydroelectric power is enormous. For discussion of this subject see topic Power.

Streams for transportation purposes are the Ohio, Levisa Fork and Tug Fork, Big Sandy, Kentucky and its chief tributaries, Green, Barren, Cumberland, and Tennessee. Thus Louisville is connected by water with the Gulf of Mexico and elsewhere along the navigable waterways of the Mississippi drainage system.

Zinc.—Zinc ores are obtained in the flourspar veins of Kentucky.

Various mineral products can readily be shipped-in to Louisville from other states.

Soils of Jefferson County

Several different kinds of soil occur in Jefferson County. The most common type is a clayey loam of medium to high fertility which is derived from the limestone strata. It yields excellent crops of corn, wheat, potatoes, tobacco, and affords good pasturage.

The Ohio shale gives a stiff, whitish clay loam. It is mixed in certain regions with sandy material washed down to the lowlands from the knobs. The swamp land near South Park has been reclaimed and yields corn, vegetables, and is used for pasturage.

The New Providence shale furnishes a soil similar to that of the Ohio shale. The crests of the ridges and knobs in the southern part of Jefferson County have a soil derived from the Warsaw limestone. It is a light clay loam and yields good crops of corn, vegetables, and fruit. The location is especially adapted to peach orchards of which there are a number.

Along the stream and river terrace of glacial outwash is a sandy loam. It is a good soil for various kinds of crops. (Ref. 6:242.)

Agriculture of Jefferson County

The chief crops of Jefferson County are corn, wheat, oats, potatoes, truck crops, fruit, tobacco, hay and forage, with dairying, stock raising and poultry also important industries.

Jefferson County and adjacent parts of Oldham County are noted for their large production of potatoes. Two crops of potatoes per year are produced in this district. The soil is a clay loam. Marketing of the potatoes is facilitated by a potato produce exchange or association at St. Matthews and Buechel. Receiving stations are also located at O'Bannon and Worthington. The potatoes are shipped to Louisville, throughout the Mississippi Valley, and some even to Central and South America. The importance of this industry is due to the large market offered by Louisville and the excellent railroad facilities of that city.

The Louisville market also makes Jefferson County important in market gardening, fruit growing, dairying, and similar industries that thrive near a large city. The roads are good for automobiles and wagons, and there are electric and steam railroads, all of which make it easy to get agricultural products to the market. In 1910 there were in Jefferson County 3,093 farms and in 1920, 2,826 farms. Farms averaged 64.2 acres in 1920. The assessed value per acre was $121.19 and that of all property per farm, $11,792. The gross crop return per farm was $2,518.96.

Agriculture Outside of Jefferson County

To the eastward of Louisville lies the rich Bluegrass region of Kentucky, while other more level areas of the State also furnish agricultural products abundantly and have good transportation facilities to Louisville. The more important crops are tobacco, corn, oats, wheat, rye, barley, hemp. Some cotton is raised though the chief source of cotton is from the Southern States. Forage crops are grown everywhere in the better agricultural regions. Orchard and small fruits are important in cetain sections. Animals raised are: horses, the Bluegrass being especially noted for its thoroughbred horses; mules; cattle, both for meat and for the production of dairy products; sheep, although not in such numbers as would be expected from the favorable topographic conditions on account of dogs; swine, especially in those regions having a large corn production; poultry; bees. On all sides of Louisville stretches the corn belt of the United States, while the important wheat producing states

are near. Thus agricultural products are brought to Louisville not only from Kentucky, but from other states for the railroads reach out in all directions for long distances and to regions of contrasting climates and agricultural products.

Timber

Woods of various kinds can be readily gotten to Louisville from the great forest areas of the United States. To the north lie the forest of the Great Lakes; to the southeast the lumber belt of the Appalachian Highlands; while the hardwood forests extend from New York to Alabama, from Louisiana to the lower Great Lakes, and from Tennessee to the western edge of the Ozarks.

Kentucky furnished lumber in 1923 from the following kinds of trees: oak, yellow poplar, beech, chestnut, hickory, red gum, yellow pine, maple, hemlock, ash, basswood, cypress, white pine, walnut, sycamore, cedar, cottonwood, elms, birch and species of minor importance. Hardwoods made up about 92 per cent of the total volume of timber cut in Kentucky. Oak furnished about 54 per cent of the total cut, poplar 10 per cent, and the other woods mentioned above in smaller per cents.

Due to Louisville's favorable location to these great timber supplies, the city is a leading lumber market and woodworking center.

Power

Electricity for power and lighting is furnished by the Louisville Gas & Electric Company from their Waterside Station steam plant, the electric generating capacity being 125,300 horse power. Cost of electric power to large consumers is as low as eight mills per kilowatt hour, "with contract base on the cost of coal delivered in the company's bunkers at the power station." (Ref. 18:15.)

There has been a steady, yearly increase in the number of kilowatt hours of electricity sold by the company. The number of electric meters increased from 43,896 in 1920 to 69,920 in 1925. In 1924 there were 700 miles of electric lines.

Additional sources of electrical power will soon be available. At the Falls of the Ohio the Louisville Hydro-Electric Company

has a great hydro-electric project under construction which it is stated will be the seventh largest in the United States, in number of horse power developed. The initial capacity will be 108,000 horse power, which will be increased to 135,000 horse power. The amount to be expended on this plant at first will be $7,500,000. An auxiliary steam plant will be erected with a capacity of 250,000 horse power. The final cost of these projects will be $25,000,000 exclusive of the dam at the Falls of the Ohio. The dam is being constructed by the United States Government chiefly for navigation purposes, but the height of the dam will be increased for the better development of power, this being done under a lease agreement with the Louisville Hydro-Electric Company. (Ref. 23:6.) A plant will also be erected on the Indiana shore. A line extends to Dix River dam. Kentucky possesses enormous potential hydro-electric power.

Fuel

Coal and natural gas are described under Natural Resources.

Labor

Louisville has an excellent supply of skilled and unskilled labor, both male and female, which is almost entirely American born as shown in the population table. There has been but little friction between employers and employees.

Kentucky labor laws and for comparison, those of several other industrial states, are as follows:

Labor Laws

State	Hours of Labor Under 16		Age of Employment	Night Work Forbidden to 16 Between		Age for Work at Dangerous Machinery
	Day	Week		P.M.	A.M.	
Illinois	8	(6 day)	14	7	7	16
Kentucky	8	48	14	6	7	16
New York	8	44	14	5	8	16—18
Massachusetts	8	48	14	6	6:30	16—18
North Carolina	11	60	14	9	6	16
South Carolina	10	55	14	8	6	14

(Ref. 33.)

The Kentucky laws state with regard to female labor: "No female under 21 years of age shall be employed or suffered or permitted to work at any gainful occupation except domestic service and nursing, more than sixty hours in any one week, nor more than ten hours in any one day.

"No female of whatever age shall be employed, or suffered, or permitted to work in any laundry, bakery, factory, workshop, store, or mercantile, manufacturing or mechanical establishment, or hotel, or restaurant, telephone exchange or telegraph office, more than sixty hours in any one week, nor more than ten hours in any one day." (Ref. 16.)

A large proportion of workers in Louisville own their own homes, have bank accounts; and a great many have stayed with their employers for many years. The open shop is favored.

Transportation

There are nine trunk line railroads, three branch lines, ten interurban electric car lines, and several bus lines serving Louisville, while the Ohio River furnishes water transportation. Three great bridges span the Ohio River and connect Louisville, New Albany, and Jeffersonville.

Steam Railroads.—The railroads entering Louisville are: Baltimore and Ohio; Big Four; Chesapeake & Ohio; Illinois Central; Louisville, Henderson & St. Louis; Louisville & Nashville; Monon; Pennsylvania; Southern. These lines and their divisions reach Montreal, Boston, New York and other Atlantic ports; southward to Jacksonville, Miami, Mobile, New Orleans, and other points; northwest to South Dakota, Minnesota and intermediate towns and cities such as Chicago, and eastward along the Great Lakes to Cleveland, Buffalo, and other points. First class connections give service to the Pacific Coast and elsewhere throughout the continent.

Louisville has an unusually good rate situation, is an Ohio River gateway, and a rate basing point with a long line of established commodity rates. A first class package car service is maintained to all the principal towns and cities, and also excellent through schedules. A trap car service is afforded by all lines to aid the movement of small shipments. The Ohio River is an important factor in the freight rate situation at Louisville.

A heavy traffic reaches Louisville chiefly from the East and South, with large numbers of cars sent to local shops for repairs or to the storage yards connected with the terminals, and an excellent supply of empty freight cars for loading is available.

The Kentucky & Indiana Terminal Railroad Company serves several of the trunk lines. And the railroad lines as a whole are so closely connected as to form trackage entirely encircling the manufacturing districts, thereby making a manufacturing plant located on one railroad practically located on all nine trunk lines. So efficient are the terminal facilities that "when other gateways have been closed Louisville has been open and traffic kept moving."

A new industrial territory is now being opened up. It covers about 1,200 acres and is available for factory sites. It is served by a double-track industrial belt line of the Kentucky & Indiana Terminal Railroad Company. The land is almost flat and has natural drainage. City water, gas and electricity are available.

Electric Railroads.—The Louisville & Interurban Railroad Company operates cars from Louisville to Shelbyville, La Grange, Prospect, Fern Creek, Jeffersontown, Okolona, and Orell. The Interstate Public Service Company operates trains from Louisville to Sellersburg, Scottsburg, Seymour, Columbus, Edinburg, Franklin, Greenwood, and Indianapolis. Two of the bridges across the Ohio River serve interurban electric railways.

In the city of Louisville the Louisville Railway Company has 186 miles of lines. Service continues day and night to nearly every part of the city. City and suburban lines south of Ohio River run 334 cars and carry 90,000,000 passengers annually. (Ref. 18:9.)

Bus Lines.—Bus lines operating between Louisville and other towns and cities, December 7, 1926, were as follows: Barnes Brothers, Consolidated Coach Company, Gold Seal, Greyhound, Pierce Bus Line, Southland Transportation Company, Tates Bus Line, Taylorsville Bus Line. Bus service was maintained between Louisville and the following points: Bardstown, Bowling Green, Carollton, Cincinnati, Danville, Evansville, French Lick, Lexington, Shepherdsville, Taylorsville.

Licensed motor vehicles in Louisville and Jefferson County in 1923 totaled 28,979, including 23,917 automobiles and 5,062 trucks. Jeffersonville and New Albany had approximately 5,000 additional motors of various kinds.

Auto trails leaving Louisville are the Dixie Highway, Boone Way, L. L. L. Highway, Atlantic-Pacific Highway, Roosevelt-Midland Trail. These main auto roads are "piked" and kept in good condition. The K. & I. Bridge to New Albany handles vehicular traffic.

A municipal tourist camp is at Poplar Level Road near Eastern Parkway.

River Navigation.—The Ohio River which borders Louisville on the north affords a fine highway for commerce. The influence of the river and the Falls of the Ohio upon the growth of Louisville have already been described. The Ohio River is important also in the making of transportation rates. The river traffic is of far less importance than before the development of railroads; and difficulties in navigation encountered during periods of low water tend to decrease the river traffic. But improvements in the Ohio River during the past few years, together with certain economic factors, have increased the quantity of goods shipped by water. The United States government is at present working on a project which contemplates the construction of a series of locks and movable dams to provide a minimum channel depth of nine feet from Pittsburgh, Pennsylvania, to Cairo, Illinois.

Packets and barges serve Louisville. The Louisville & Cincinnati Packet Company operates one boat each way daily, except Saturday. The Louisville & Evansville Packet Company operates boats between the cities named. These packet lines handle livestock, poultry, cream, and carry passengers. The Inland Waterways Company has its headquarters at Louisville. It operates towboats and barges on the Ohio and Kentucky Rivers, carrying heavy, bulky products such as lumber, stone, sand, gravel, brick, iron products, and the like. Through fleets of barges loaded with iron pipe, wire, nails, and various steel products, come past Louisville from the Pittsburgh district, dropping off some products at Louisville, and carrying the rest to points further downstream. Coal barges also come down the river. In 1924 there were barged to Louisville 45,341 tons of coal from Eastern Kentucky, West Virginia, and Pennsylvania, and coal is also barged to points downstream.

Dredges obtain sand and gravel from the river banks and bars. The Ohio River Sand & Gravel Company has a large plant at Louisville. Theatre boats pass up and down the Ohio, and the Louisville & Jeffersonville Ferry Company operates boats between these two cities. Along the Ohio River bank are the wharfs of the Louisville & Cincinnati Packet Company, and the Falls Cities Ferry. At the foot of Third Street on the Ohio River is the United States Coast Guard Station.

Aviation.—A government commercial aviation field known as Bowman Field, is located at Taylorsville road.

Markets

The area in which each product manufactured at Louisville can be marketed is determined by a number of factors, so that a study should be made in each case. Space will not permit such a study in this report. Suffice it to say that many industries of Louisville find a market for their products within the city itself. Other industries due to Louisville's strategic and geographic position and additional favorable factors for manufacture and distribution of goods, sell their products advantageously throughout a wide territory. Louisville's more important rivals for the southern markets are Cincinnati and St. Louis, while in more restricted areas goods from Lexington, Nashville, Knoxville, Memphis, Chattanooga, Atlanta, Birmingham, and similar cities compete with Louisville products, as well as have the advantage in certain lines of their own. In other directions Louisville soon comes into competition with industrial cities but so excellent is Louisville's industrial position that it is able to market certain products throughout the United States and even the world.

Manufactures

Louisville possesses the necessary factors for the successful operation of a large number of various classes of industries. These elements of success are: an abundance of accessible raw materials; ample and cheap power and fuel; plentiful, efficient labor; good, inexpensive transportation facilities from the raw materials to the factories and from the factories to large markets; and a stimulating climate. Also industries at a large center have

at hand great financial institutions for the financing of their needs. The sum of all these elements are unusually favorable at Louisville, with the result that it has become a great industrial and commercial city and the growth is continuing steadily.

Louisville industries are so numerous and varied in character that business conditions are, as a whole, more stable than conditions in a city where only a few types of industries predominate. Industries listed in the United States Census of Manufactures, dated 1922, for the city of Louisville totaled 152.

Since the above census was taken the number of manufactures has increased. On June 30, 1926, Louisville had 892 factories which produced over 10,200 different kinds of articles. In 1925 the value of manufactured products was $382,590,000.00 which gave Louisville first rank south of the Ohio and Potomac rivers. (Ref. 9.)

At Louisville are located a number of manufacturing industries which are the largest of their kind in the world. There are: the largest plant in the world manufacturing enameled iron and brass plumbing supplies; the largest plant manufacturing absorption, ice, and refrigeration machinery and drop valves and fittings; the largest plant manufacturing wagons; the largest manufacturer of hickory handles; the largest plant making composition lead and tinfoil; the largest soft winter wheat flour mill; the largest plant making baseball bats; the largest plant manufacturing table rims and slides; the largest plant making boxes; the largest printing plant for books for the blind; a plant having the largest reed organ output in the world; a branch of the world's largest exclusive cake manufacturer; the largest single unit hardware plant; the largest exclusive steel and copper trade engravers; the largest automobile body plant; largest manufacturer of minnow buckets; largest manufacturer of nicotine products; the largest plant manufacturing fireplace fixtures.

Louisville contains, in addition to the plants listed above, several plants which are among the largest of their kind in the United States. There are: one of the largest millwork plants in the United States and the largest in the South; one of the largest agricultural implement manufactures; the largest Presbyterian newspaper on the continent and the oldest religious newspaper in the world; the largest manufacturer of high class

wood mantel-pieces in the United States; the largest oxygen and hydrogen plant; the largest manufacturer of cabinet varnishes; the largest casket plant; the oldest pipe-organ plant.

Plants at Louisville which are the largest in the South, exclusive of those previously mentioned, are: the largest millinery house; the largest manufacturre of stampings and dies south of Ohio River; the largest manufacturer of mirrors and framed mirrors in the South; the largest cold storage plant; the largest manufacturer of saddles and harness; the largest paint plant south of the Ohio River; the largest ice cream plant in the South; the largest cut stone and monument plant; the largest manufacturer of tin tags; the largest complete printing plant south of the Ohio River; the largest plant in the South making soap; the largest manufacturer of metal windows and doors; the largest boiler plant south of the Ohio River.

Reasons for the location of the various individual industries at Louisville are seen by noting the fundamental factors of natural resources, power, labor, transportation, and markets described in this report, that are of especial importance to the industry considered. Thus Louisville is the world's leading tobacco market, and a principal tobacco manufacturing center due to its proximity to the great tobacco producing areas of Kentucky, the other basic factors mentioned above being favorable. The large shops of the Louisville & Nashville Railroad give employment to a great number of men being located here since it is such a very important railroad center. Access to the great timber supplies and markets, skilled labor, up-to-date equipment, power, and other factors have made Louisville a leader in the manufacture of veneers, panels, compound lumber; and determined the location in this city of a variety of other woodworking industries. Pig iron and semi-finished iron and steel products can readily be shipped to Louisville from the iron and steel centers of the United States on the north, east and south. Louisville is the leading livestock market of the South. Space will not permit the detailed discussion of each of the main classes of industry, but the factors determining their location at Louisville are quite apparent.

In addition to the major industries are many industries that mainly owe their location at Louisville to the major industries which they serve. There are still opportunities for the establish-

ment of new industries at Louisville that should prosper by being complimentary to major industries already established. For example, Louisville has a number of mirror plants which sell to furniture manufacturers. The glass is obtained from works in the East. If a glass manufacturing plant were located at Louisville it would appear as though it could secure a sale for its products to the mirror plants and other factories using glass. Kentucky contains near Louisville, the necessary raw materials for glass manufacture as previously stated in this report. Raw materials for soap manufacture can easily be assembled at Louisville, many of the ingredients being produced at Louisville plants. The establishment of another soap plant would appear to be a successful undertaking. Other opportunities exist, but so rapid is the industrial growth of the city that openings for new plants are being filled. With increase in industries, however, additional new opportunities appear.

Louisville Foundation

The Louisville Foundation was organized for the purpose of establishing additional industries in Louisville and in aiding meritorious plants already in the city. The Foundation has a fund of $1,024,600 which was raised by the stock subscriptions of 3,118 citizens. Loans can be made to firms meeting the approval of the Foundation "in an amount not exceeding one-third of the total capital of any industry. A limit of five to ten years on the duration of loans makes the fund a revolving one. The Foundation is supervised by five officers and fifteen directors." (Ref. 22:1.)

Louisville Today

Louisville at the present time has an area of 39.2 square miles. The population has rapidly increased from 234,891 in 1920, to 305,935 in 1925, and 311,000 (estimated) in 1926. (Ref. 19.) More detailed statistics regarding the population have already been given under the topic Population.

City Government

The city government consists of a mayor, board of alderman, board of councilmen, together with all of the other offices and departments that go with a large American city.

Public Utilities

Natural and Artificial Gas.—Natural gas is piped to the city from West Virginia and eastern Kentucky fields. Supplementing the natural gas supply, the Louisville Gas & Electric Co., has constructed a large artificial gas plant. The company's gas reservoir capacity is 12,300,000 cubic feet. The number of gas meters increased from 44,737 in 1920 to 64,435 at the close of 1925. There were 828 miles of gas mains in 1924. The rate charged for natural gas is 35 cents per thousand cubic feet. During the winter months when artificial gas is also used the rate is 45 cents per thousand. (Ref. 21;7.)

Electricity.—Electricity is furnished the city by the Louisville Gas & Electric Co.. There were in 1924, 700 miles of electric lines. The number of electric meters increased from 43,896 in 1920 to 69,920 in 1925. The rate for electricity for ordinary lighting purposes is 8 cents per K. W. H. A monthly consumption of 500 K. W. H. and over is 5 cents per K. W. H.

Electricity is discussed further under the topic Power.

Telephones and Telegraph.—Telephones in Louisville increased from 40,181 in 1920 to 54,127 in 1925. The Southern Bell Telephone and Telegraph Company serves Louisville. The Western Union lines also are available.

Water Works.—The Louisville Water Company which supplies the city, is a corporation owned and controlled by the city. The water is taken from the Ohio River, passed through a modern, sand-filtration plant, chlorinated and delivered for consumption, clear and pure. There is thus an inexhaustible supply of water. The plant cost $20,000,000. It has a pumping capacity of 112,000,000 gallons per day. The average daily pumpage is 41,882,480 gallons. The maximum daily consumption is 60,000,000 gallons. In case of fire the water pressure can be increased until water can be thrown to the tops of the highest towers in the city. Water mains extend to all parts of the city. The water is of average hardness and does not reduce the efficiency of the equipment in manufacturing plants, nor corrode or pit flues. The hardness of the treated water, according to F. C. Dugan, Director of the State Bureau of Sanitary Engineering, is 40 to 125 p. p. m., or an average of 85 p. p. m. The total hardness of the raw water and the treated water is about the same.

The cost of the city water in large volume for manufacturing purposes is four cents per thousand gallons. Water connections in Louisville from 1920 to 1925 increased from 45,778 to 60,825.

Excellent well water can be obtained for process purposes at an average depth of 80 feet. Cost of pumping is one cent per thousand gallons. Well water is not considered uniformly safe for drinking purposes.

Sewers.—There is a system of modern, sanitary sewers. A $5,000,000 program of trunk line sewer extensions is underway which is following a previous expenditure of $5,000,000 for sewers. (Ref. 23.)

Streets.—There are 339 miles of streets of which 250 miles are paved. Automatic traffic signals have been installed.

Streets bearing numbers such as Seventh, Eight, etc., extend away from the Ohio River. Streets bearing names occur parallel to and before the numbered streets commence, and also extend between and parallel to the numbered streets. Other streets with names run at right angles to those bearing numbers. The most important part of the business district is situated between Brook Street on the east and Eighth Street on the west. Brook Street is one block east of First Street to which it is parallel. Fourth Street is an important retail business street; and also has most of the theaters, and many of the better known restaurants. The manufacturing and wholesale plants are not limited to any given area but are scattered either within or in all directions from the business section. (Ref. 20:39; 31; 32.)

Danger of accident at railroad crossings will soon be a thing of the past. The city and the railroads have completed plans for the elimination of grade crossings at a cost of $15,000,000 to $20,000,000. (Ref. 23:7.)

Transportation Facilities.—Louisville is served by nine trunk line railways, electric lines, busses, and on the Ohio River, packets and barges. Fifty-five steam passenger trains and over 200 electric interurban cars arrive and leave the city daily. The steam railways have two union stations and there are seven passengers stations or station stops. The interurban electric cars and buses also have their stations. There are 186 miles of electric lines in the city. For additional facts see the main topic Transportation.

Financial Statistics of Louisville

Taxes and Exemptions.—"Under the state law," to quote the Louisville Board of Trade and Industrial Foundation (Ref. 18:17, 25), "manufacturers are perpetually exempted from all local taxes on machinery, raw materials and materials in process of manufacture." Prior to the enactment of this statute Louisville had granted to new manufacturers complete exemption from all city taxes for a period of five years. The city of Louisville tax rate is $2.78 but various exemptions on manufacturing reduce the total tax to about 70 cents during the first five years. After five years, allowing for exemptions under the state law, the rate becomes $1.378.

General Property Taxes*

Assessed Valuation† (000 omitted)	Levy			
	Total, 1925 (000 omitted)	Per Capita		
		1925	1924	1917‡
$366,540	$7,232	$24.17	$23.13	$16.65

Revenues**

Total, 1925 (000 omitted)	Per Capita			General property, special and poll taxes (000 omitted)	Licenses (000 omitted)	Special assessments and charges (000 omitted)	Subventions, donations, and pension assessments (000 omitted)	Earnings of general departments (000 omitted)	Earnings of public service enterprises (000 omitted)	All other revenue (000 omitted)
	1925	1924	1917‡							
$11,356	$37.96	$33.89	$25.85	$6,808	$744	$806	$836	$474	$1,326	$362

*U. S. Census of 1925.
†The valuation reported is that on which are based the levies made in the year reported.
‡For fiscal year ending June 30, 1917, or fiscal period closing prior thereto.
**Revenue receipts do not include proceeds of bond issues. Receipts on account of issuance of debt obligations are not considerated revenue.

Government Cost Payments and Net Debt.—This data for Louisville is given by the United States Census 1925, as follows:

GOVERNMENTAL-COST PAYMENTS[1]

Operation and maintenance of general departments (000 omitted)	Operation and maintenance of public service enterprises (000 omitted)	Interest (000 omitted)	Operation, Maintenance and Interest				Outlays for permanent improvements, 1925 (000 omitted)
			Total 1925 (000 omitted)	Per Capita			
				1925	1924	1917[4]	
$6,881	$458	$719	$8,058	$26.94	$26.81	$18.24	$3,803

Excess of Revenue Receipts[1] Over—		Net Debt[2]				
Total Governmental-Cost Payments[3] (000 Omitted)	Payments for Operation, Maintenance and Interest[3] (000 Omitted)	Total 1925 (000 Omitted)	Per Capita			Increase or Decrease (—) in Net Debt, 1925 (000 Omitted)
			1925	1924	1917[4]	
—$504	$3,298	$15,321	$51.22	$46.83	$52.55	$1,712

[1] Governmental-cost payments include all payments for the year whether made from current revenues or from the proceeds of bond issues. Receipts on account of the issuance of debt obligations are not considered revenue receipts.
[2] Net debt is funded or fixed debt less sinking fund assets.
[3] A minus (—) indicates an excess of payments over revenue receipts.
[4] For fiscal year ending June 30, 1917, or fiscal period prior thereto.

POST OFFICE RECEIPTS*

1925	$2,736,415
1924	2,587,539
1923	2,427,107
1922	2,255,529
1921	1,966,150
1920	1,839,033

*Data furnished by Louisville Board of Trade, December 13, 1926.

ALL BUILDING CONSTRUCTION*

	Permits	Outlays
1925	5,826	$29,910,246
1924	5,128	22,682,959
1923	5,212	17,026,651
1922	4,186	16,736,750
1921	3,271	7,428,300
1920	2,493	6,986,260
1919	2,163	4,140,714
1918	1,213	1,991,632
1917	1,265	1,806,150
1916	2,363	3,934,846
1915	2,434	3,933,790
1914	2,287	4,388,480
1913	2,426	4,070,480

*Twelfth Biennial Report 1924-1925, Department of Labor, p. 55.

BANKS

Louisville has the Louisville Clearing House, nineteen banks, and five trust companies. There are several building and loan associations. One of these with a capital of $50,000,000, is said to be the largest in the world. (Ref. 20.) There is located at Louisville a branch Federal Reserve Bank of St. Louis, a Federal Land Bank, and an Intermediate Farm Loan Bank. There are forty-two business associations. The Louisville Industrial Foundation, Inc., is an important factor in aiding worthy industries.

It is stated that a larger percentage of citizens in Louisville are worth over $5,000 than in any other city in the United States.

BANK DEBITS, CLEARINGS, AND DEPOSITS*

Year	Bank Debits	Bank Clearings	Bank Deposits
1925	$2,253,176,085	$1,731,217,000	$138,587,494
1924	2,009,623,248	1,569,027,000	133,979,050
1923	1,908,181,777	1,534,040,000	114,848,160
1922	1,638,160,621	1,277,749,000	118,652,780
1921	1,503,956,793	1,249,357,000	90,788,177
1920	1,718,711,501	1,153,048,000	97,871,764

*Data furnished by the Louisville Board of Trade, December 13, 1926.

EDUCATIONAL FACILITIES

There are seventy-seven public school buildings and forty-three used for parochial schools. Enrollment in the public schools in April, 1925, was 45,471; in parochial schools 12,824. There were 1,096 teachers in the public schools and 232 in parochial schools. The estimated value of Louisville public school property is $5,618,935. The annual cost of operating the public schools is $2,193,000. There are forty private schools including seven business colleges. Schools for nurses are the Louisville City Hospital Training School (white) and the Red Cross Training School (colored). An important school is the Kentucky Institute for the Blind.

There are a number of institutions of advanced learning in Louisville. The University of Louisville, established November 21, 1837, is the oldest municipal university in the United States.

Simmons University (colored) is at Louisville. Two well known theological training schools are the Southern Baptist Theological Seminary and the Presbyterian Theological Seminary.

Libraries and Churches

The Louisville Free Public Library consists of a central library and fourteen branches. There are 258,385 volumes in the library. In addition to the public library there are: the Louisville Law Library, United States District Court Library, Y. M. C. A. and Y. W. C. A. Libraries, Y. M. H. A. Library, college and sectarian libraries.

There are 329 churches of which 231 are white and 98 colored. The total value of the church property is more than $8,000,000. Statistics indicate that Louisville has a larger percentage of church members for each 1,000 population than any of the larger cities of the United States.

Newspapers

Prominent daily newspapers are the Courier-Journal, Times, Herald-Post. Periodicals and other types of publications are also printed at Louisville.

Housing Conditions

Homes and Apartments.—The industrial worker owns his home to an unusual extent compared with other large cities. This is in part due to the evenness of the topography which permits easy access to the places of employment. Houses and apartments are obtainable to suit the means of those interested. A good five-room house with gas, electricity, and water, can be secured for a monthly rental of from $20.00 to $25.00.

Buses, electric cars, and railroad lines make commuting to nearby towns and rural communities easy and pleasant. Many people thus live in the country and work in the city.

Hotels.—There are many excellent hotels. In alphabetical order the more prominent are the Brown, Chesterfield Apartments, Elks Home and Hotel, Hermitage, Kenton, Kentucky, Kosair Shrine Hotel, Louisville, Plaza, Seelbach, Tyler, Victoria, Watterson, Willard. In seven of the larger of these hotels there is a total of 2,297 rooms. They also have public rooms adapted for large banquets, conventions and the like. Rates are reasonable for the type of service given; and one can choose a hotel to suit his means. There are also numerous rooming houses.

Asylums and Homes.—There are forty-one asylums and homes. Among these recent institutions is the $1,500,000 Masonic Widows' and Orphans' Home. There are nineteen charitable institutions and eight settlement houses.

Business Firms.—In 1920 there were 8,337 business firms, in 1926 there were 10,459.

Office Buildings.—There were in 1926 sixty-three office buildings in Louisville.

Civic, State and Federal buildings in the business district:

City Hall.
City Hospital.
Custom House and Post Office
Jefferson County Armory
Jefferson County Court House.
Louisville Board of Trade.
Louisville Free Public Library.
U. S. Coast Guard Station.

Cost of Living

The average cost of living in Louisville has been calculated to be four and one-half per cent below the average for fifty-one of the largest cities in the United States.

Protection of Property

Fire Department.—The City Fire Department consists of 330 full time men and 10 substitutes. There are 23 engine companies, 8 hook and ladder companies, 2 chemical companies, and 1 water tower company. The equipment is valued at $900,000. This includes 15 auto pumping engines, 3 motorized steamers, and 5 horse drawn steamers. Throughout the city there are 2,550 fire hydrants and 634 fire cisterns.

According to the National Board of Fire Underwriters reports for the five years prior to 1920, Louisville's per capita fire losses during that time averaged $2.20 as compared with an average per capita loss of $2.34 for more than 300 American cities having a population of 30,000 or more. (Ref. 18:35.)

Police Department.—The Police Department comprises 425 men.

Hospitals

There are in Louisville 36 hospitals, sanatoria, infirmaries and clinics under Federal, State, municipal, sectarian and private control. Recent buildings are St. Joseph's Infirmary costing $1,500,000, and Waverly Hills Tuberculosis Hospital costing $1,250,000.

Louisville is indeed a medical center as here are the headquarters of the Kentucky State Board of Health with its laboratory school, and the School of Medicine and Dental School of the University of Louisville. Numerous specialists in various branches of medicine and surgery are also located here.

Vital Statistics**

Total Deaths Reported in Louisville.

Year	All Deaths	Rate Per Thousand	Tuberculosis (All Forms)	Pneumonia	Whooping Cough	Diphtheria	Typhoid Fever	Diarrhoea (Under 2 Years)	Cancer	Infant Mortality Rate
*1925	4,260	13.7	336	361	25	9	18	114	330	81
*1924	3,929	15.2	286	369	7	15	10	88	294	.....

*Total deaths of city residents from tuberculosis including those occurring at Waverly Hills Sanatorium. Total: 396 in 1925; 350 in 1924. The birth rate per 1,000 population at Louisville was 20.0 in 1925 and 24.3 in 1924.
**Data from Preliminary Vital Statistics Report for 1925. State Board of Health of Kentucky.

Cemeteries

There are at Louisville twenty-two cemeteries of all faiths. General George Rogers Clark is buried in Cave Hill Cemetery while near Louisville is buried General Zachary Taylor, once President of the United States.

Conventions and Fairs

Louisville is a popular convention center for national and international meetings. Its numerous well-appointed hotels, its central location, and ready access from all parts of the United States, all add to the success of these gatherings. There were ninety conventions held in the city in 1922. The great manufacturers' building of the Kentucky State Fair is one of several places which are available for conventions. The Louisville Convention and Publicity League sees to the success of the conventions and pleasure of those attending.

The Kentucky State Fair is an important event. The location is excellent and there are well equipped exhibition buildings, race track, and the like. Some years more than 216,000 people attend.

Recreational Attractions

Louisville has 21 parks and playgrounds with a total area of 1,464.2 acres. There are 56 public tennis courts, 23 baseball diamonds, two swimming pools, and one 18-hole golf course. Cherokee and Iroquois parks are said to be among the most attractive in the United States in their natural beauty.

In the city's environs there are also, four country clubs, two with 18-hole golf courses, and one with a nine-hole course. On the Ohio River are two boat clubs. There are eleven private and amusement parks in the city. Louisville has a professional baseball team in the American Association. The Churchill Downs race track and the Kentucky Derby are known to those interested in horse racing throughout the world. Each year around 80,000 people attend the races which start early in May and continue about twenty days. Racing in the autumn is usually in November.

Louisville contains about 45 theaters and motion picture houses. The best dramatic talent and theatrical productions come to Louisville during the year.

Sportsmen's organizations include the Louisville Gun Club, Louisville Country Club, Louisville Gymnastic Association (Turners), Audubon Country Club, Standard Club, Cherokee Golf Club, Louisville Chess Club, New Albany Country Club, Pastime Boat Club, Louisville Gymnastic Association (Turners) Boat Club, Louisville Boat Club, South Park Fishing Club.

Louisville of the Future

With increase in industrial development and population of the regions in which Louisville products are marketed there will be a greater demand for certain products. Within the city itself, increase in manufacturing and other enterprises, and in population will necessitate a greater production of goods. Comple-

tion of the Ohio River improvements will give excellent water transportation throughout the navigable waterways of the Mississippi River Basin. Increased cheap electrical power and more efficient methods of manufacture will increase production.

Regarding sources of raw materials, the forests should be cared for scientifically for upon the forests depend many large industries of Louisville. When the forests are cut away for such a distance from Louisville that lumber cannot be economically shipped to the city, then the great woodworking industries will have to move to more favorable locations, or turn to the manufacture of products other than wood. The soils of the farms that ship their products to Louisville should be kept in a state of high fertility and the farmers aided, for the city depends upon the farmer for food, and numerous different kinds of raw materials from the farms enter into Louisville's manufactured products. Mineral resources thus far practically untouched await development. With the exhaustion of the Lake Superior iron ores, Louisville is still favorably situated to the great iron ore fields of Tennessee and Alabama. And within the boundaries of Kentucky, are large deposits of low-grade iron ore which some future day will be of value. Many mineral products such as shale, clay, limestone, sand, gravel, which are being used at present occur in enormous quantities and are practically inexhaustible. Coal will last a very long time and large areas in Kentucky have yet to be reached by railroads. The other mineral resources described in this report will last for generations to come, with the exception of petroleum and natural gas. Substitutes for these two products are found in the oil shale of Kentucky and Indiana, which is a source of oil and gas, and artificial gas which is derived from coal.

The attractive features of Louisville's living conditions such as parks, public schools and institutions of higher education, pleasant homes, the ease with which those preferring to live in the country can commute to work in the city, and the high type of the population, in general, all make people eager to settle in Louisville and contented to remain.

Louisville has become one of the great industrial and commercial cities of the United States. Growth has been steady and based on sound economic conditions. These same fundamental factors will continue to operate making Louisville's future very bright.

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